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COLORADO SCHOOL OF MINES MAGAZINE

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VOLUME IX

January 1, 1919, to December 31, 1919

THE COLORADO SCHOOL OF MINES ALUMNI ASSOCIATION, PUBLISHERS, GOLDEN, COLO.

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VOL. IX JANUARY, 1919 NO 1

COLORADO SCHOOL OF MINES MAGAZINE

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COLORADO SCHOOL OF MINES MAGAZINE

VOL. IX. GOLDEN, COLO., JANUARY, 1919 No. 1

ANNOUNCEMENT

The war is over. The opportunity has arisen to renew publication of our magazine. This demands strenuous efforts under the present circumstances and is possible, first, through the loyalty of Geo. O. Marrs of the Class of 1901, who has just been discharged from the Officers' Training Camp at Fort Zachary Taylor, Ky., and who has generously offered to supervise the editing of the magazine until such time as other suitable arrangements can be made; and second, through the promise of financial aid, temporarily, by Denver Alumni.

Quite naturally these arrangements are temporary only and in order to continue the magazine, reliance is placed in the loyalty and support of the Alumni as a whole. Of this lowalty, those above mentioned who are furnishing the "Sinews of War" have no doubt.

There will be mailed with this number a statement of dues, and except to those whose subscription has been paid beyond this date, a statement for one year's subscription, both of which are **payable in advance.** Your part is to **remit immediately.**

We fully expect hard going for the first few issues, but if each member of the Alumni will send in articles, patronize our advertisers, boost for the magazine, and, by no means the least, send remittances promptly, our efforts will be successful.

Harvey Mathews, Class of '13, will be editor of the magazine temporarily under the supervision of Geo. O. Marrs.

What we need is ginger. Will each Miner furnish his quota?

Earnestly yours,

Daniel Harrington, '00
Edwin H. Platt, '00
Thomas B. Crowe, '00
Executive Committee.

A. K. McDANIEL,
President.

Radioactivity and Radioactive Transformations

By DR. FRANK E. E. GERMANN,
Professor of Physics and Electrical Engineering, Colorado School of Mines.

HISTORICAL

The term radioactivity is now generally understood to signify the property shown by a class of substances, of which uranium, thorium, and radium are the best known examples, of spontaneously emitting special types of radiations capable of acting on a photographic plate and of discharging an electrified body.

The property of matter known as radioactivity was discovered in 1896 by M. Henry Becquerel, who observed that the salts of uranium emitted a characteristic radiation which was capable of producing an effect on a photographic plate through several thicknesses of black paper wholly opaque to ordinary light. The discovery was an indirect result of the discovery of the X-rays, made a few months before by Roentgen. It was known that the production of X-rays in a vacuum tube was accompanied by as trong phosphorescence of the glass, and it occurred to several investigators that substances made phosphorescent by visible light might emit a penetrating radiation similar to X-rays. It will be recalled that numerous salts, such as those of calcium and uranium, after being subjected to strong rays of light, become luminous when observed in a dark room. The salts of uranium become very brilliant if subjected to strong light at a temperature of liquid air,—180°C, but the brilliance is of short duration after the exciting source has been cut off. The term phosphorescence is in general applied to a long time luminescence, whereas the term fluorescence applies to luminescence which lasts only a small fraction of a second after the exciting light has been removed.

THE RADIATIONS

The radiation emitted by radioactive substances has been shown to be complex in character and to include three distinct types known as the alpha, beta, and gamma radiations. The alpha radiations consist of positively electrified atoms of helium, moving with a velocity of about one-fifteenth of the velocity of light. The element helium was first discovered by Lockyer in the chromosphere of the sun in the year 1868, and in 1881 was observed by Palmiere to be in the gases ascending from Vesuvius. It is probable that Cavendish obtained the gas helium in 1785, but did not recognize it. In the course of analytical work on uranium undertaken by Hillebrand in 1888, a gas which he thought was nitrogen was obtained upon boiling the mineral with dilute sulphuric acid. In 1895 Professor William Ramsey, having learned of Hillebrand's work and doubting whether nitrogen could be obtained in that way, prepared some of the gas by Hillebrand's method from cleveite, a variety of uraninite and found it to be helium, the element recognized in the sun and in the gases ascending from Vesuvius.

The alpha rays or positively charged helium atoms moving with a high velocity, are completely stopped by thin layers of ordinary matter and are deflected from their path by strong magnetic and electrostatic fields.

The beta radiation consists of negatively electrified particles, or electrons with a mass of about one eighteen-hundredth that of the hydrogen atom, and projected at a velocity sometimes as high as nine-tenths the velocity of light. The beta rays being lighter than the alpha rays, have a greater power of penetration and are consequently more readily deflected than the latter by both magnetic and electrostatic fields.

The most recent theoretical considerations seem to favor the assumption that the gamma radiation consists of pulses in the ether of space, traveling with the velocity of light and analagous in many respects to the Roentgen or X-radiation. The gamma rays have a high penetrative power and are not affected by either electrostatic or magnetic fields.

All three types of radiation are capable of producing charged carriers of electricity, known as ions, in the gases which they traverse and in this manner render the gases conducive to electricity. They also excite phosphorescence in various chemical compounds and produce an effect on photographic plates.

THE DISCOVERY OF RADIUM

Although the property possessed by uranium of spontaneously emitting energy in special forms without any apparent change in the matter itself could not fail to be regarded as a most remarkable phenomenon, yet the amount of energy emitted compared with ordinary standards was found to be so small that it did not attract that active scientific interest which was afterward excited by the discovery of radium. This latter substance exhibited the properties of uranium to such a remarkable degree that it impressed both the lay and the scientific mind.

Shortly after the discovery of the radioactive properties of uranium by Becquerel, Mme. Curie made a systematic examination of different substances for radioactivity and found that the element thorium possessed the same properties as uranium, and almost to the same degree. This fact was also independently observed by Schmidt in the same year, 1898. Mme. Curie, having access to the splendid mineral collections of the Ecole des Mines of Paris, proceeded to examine all the specimens, especially those containing uranium and thorium, and here the unexpected was observed. Some of the minerals were found to be more radioactive than pure uranium, and in all cases the uranium mineral showed four or five times the "activity" or radioactive property, to be expected from the percentage of uranium present. Mme. Curie found that the radioactive property of uranium was an atomic property, and therefore depended only on the amount of the element uranium present, and not at all on its combination with other substances. That is to say that were we to take Radium Chloride ($RaCl_2$) of molecular weight 297 and Radium Bromide ($RaBr_2$) of molecular weight 386 and test their relative activity, we would find that the ratio of the amounts of radium chloride to radium bromide necessary to give the same activity would be as 297 is to 386. In other words it depends solely on the number of atoms of radium present. This being true, the large activity of uranium minerals could only be accounted for by the assumption that some unknown substance was present whose activity was far greater than uranium itself.

Relying on this hypothesis, Mme. Curie proceeded boldly to see if it were possible to separate this unknown substance from the uranium minerals. By the courtesy of the Austrian government, she was presented with a ton of uranium residues from the State Manufactory at Joachimsthal, Bohemia. In this locality there are extensive deposits of uraninite, commonly called pitchblende, which are mined for the uranium they contain. Pitchblende consists mainly of an oxide of uranium, but also contains small quantities of a number of rare elements. The residues obtained by Mme. Curie, having already had the uranium removed, were very much more concentrated in the unknown substance than the original ore, consisting only of the various rare earths associated with the uranium oxide in the mineral pitchblende.

METHOD EMPLOYED

As a guide to the separation of the active substance, Mme. Curie used a suitable electroscope to measure the ionization produced by the active body. After any chemical separation the activities of both the precipitate and the filtrate evaporated to dryness were examined separately, and in this way it was possible to ascertain whether the active substance had been mainly precipitated, or left behind in the filtrate. The electric method was thus used as a rapid means of qualitative and quantitave analysis. It soon became evident that not one, but two radio-active substances were present in the uranium residues. The one, which she named polonium, in honor of Poland, the land of her nativity, was separated with bismuth. The other substance, which was separated with barium was called radium. The choice of this name was very fortunate, as the activity of pure radium is at least two million times that of uranium.

PHYSICAL AND CHEMICAL PROPERTIES OF RADIUM

The atomoc weight of radium at present generally accepted is 226. Its spectrum was found by Demarcay to consist of a number of bright lines analogous in many respects to the spectra of the alkaline earths. Salts of radium color the flame carmine. The chemical properties of radium are closely allied to those of barium, it can be separated from it by taking account of the diefference of solubility of their chlorides or bromides. The exceeding rarity of the compounds of radium has rendered impossible any extensive study of their characteristics. The chloride is described as a grayish-white powder, less soluble in water and in dilute hydrochloric acid than is the chloride of barium. The bromide gives off bromine in the air, and becomes alkaline because of the formation of the hydroxide. The hydroxide absorbs carbon dioxide and becomes the carbonate, which is insoluble.

PHYSIOLOGICAL PROPERTIES OF RADIUM

A great many physiological properties are claimed for radium, but the subject is in its infancy. By exposure of the skin to the rays of radium the skin is burned; bacteria are destroyed or hindered in development; plants lose their chlorophyll and seeds their power of germination.

ISOTOPES

At present it seems highly probable that two elements may have the same chemical properties, and show identical spectra. Such elements can be separately identified only by their diffenent atomic weights, or by means of some property which is independent of their chemical characteristics. The radioactive properties of the radio-elements offer such an independent means of identification. Radio-elements have been found which are absolutely inseparable chemically from other well-known inactive elements and many cases are recognized of radio-elements which are inseparable from other radio-elements. Elements which show this identity with other elements are called **isotopes** and their properties are said to be **isotopic.**

THE ORIGIN OF RADIUM

Uranium, having the highest atomic weight of the known elements, is the most slowly changing of all the radio-elements, its rate of disintigration corresponding to the transformation in one year of about one eight-billionth of the total amount of uranium present. The time required for exactly one half of any given quantity of uranium to disintegrate completely into other forms of matter is about five billion years. The atomic weight of uranium admitted today is 238.5, but ordinary uranium is supposed to consist of a mixture of two isotopic elements, uranium 1 with an atomic weight of 238 and uranium 2 with an atomic weight of 234. Uranium X is the first disintegration product of uranium and is gradually formed in uranium salts on standing. The amount which accumulates reaches a maximum after about 150 days, when a state of radioactive equilibrium is reached and the amount of uranium X which is produced in any subsequent time is exactly equal to the amount which disintegrates in the same period. The half life period of uranium X is 24 days. Uranium X is isotopic with thorium and when freshly prepared consists of a mixture of two isotopic elements, uranium X and uranium X_2.

IONIUM

Ionium is a radio-element intermediate between uranium, of which it is a product, and radium, of which it is the parent. It was discovered by Boltwood in 1907. Its atomic weight is probably about 230. From uranium minerals containing thorium the ionium is separated with the thorium, with which it is isotopic. Its rate of transformation has not yet been determined, but it is probably as slow as that of radium.

RAYS GIVEN OFF

Pure uranium, free from the decomposition products, emits only the alpha or positively charged helim rays. Uranium X gives off the negative eletions and uranium X_2 gives off both the elections and the gamma rays, which are similar to x-rays, and very penetrating. Ionium gives off only the alpha rays. When alpha rays are given off, we may in general expect a diminution in the atomic weight of approximately 4, which is the atomic weight of helium, the positively charged ray shot off. Thus uranium of atomic weight 238.5, loosing two atoms of helium, becomes ionium of atomic weight 230. Ionium on loosing one atom of helim becomes radium of atomic weight 226.5. Radium emits alpha rays and becomes emanation, a gas of atomic weight 222, which similar to argon and helium will not enter into chemical combination. Emanation will condense at the temperature of liquid air. Its half life is about 3.8 days.

INDUCED ACTIVITY

The half life period of radium is 1670 years. When in a closed tube, it gives rise to the so-called induced activity, due to the decomposition products of the emanation being solid and settling on the walls of the container. The products of radium emanation, taken in their order of production, are konwn as radium A, B, C, C_1, C_2, D, E and F. Radium D is commonly called "radio-lead," because it is separated with the lead from uranium minerals, and is isotopic with it. Radium F is better known as polonium, and is the element mentioned above discovered by the Curies in 1898. Its emits only alpha rays and is half transformed in a period of 136 days. The final stable inactive product of the disintegration of radium after the series of radioactive changes in an isotope of ordinary lead known as uranio-lead, having an atomic weight of about 206. This means that the radium lost one atom of helium, becoming emanation, which in turn lost four more atoms of helium, to become finally uranio-lead.

THE ELEMENT RADIUM

Following the attempt made by Markwald in 1904, Mme. Curie and M. Debierne in 1910 electrolysed a solution of radium chloride with a mercury cathode and obtained a radium amalgam which on distillation in hydrogen left a residue of metallic radium. It is a white metal melting at about 700°C. It alters rapidly in the air with the formation of the nitrate. Water is decomposed with the formation of the hydroxide.

RADIUM COMPOUNDS

The following compounds of radium have been described.

Bromide, $Ra\ Br_2$; $Ra\ Br_2.2H_2O$
Chloride, $Ra\ Cl_2$; $Ra\ Cl_2.2H_2O$
Nitrate, $Ra(No_3)_2$.

HEAT GIVEN OFF BY RADIUM

One of the most wonderful properties of radium was discovered by Pierre Curie. Radium constantly gives off heat at a rate sufficient to melt more than its own weight of ice per hour and this without any apparent change in weight. In other words one gram of radium will give off 132 gram calories per hour, sufficient to raise ten grams of water from 0° to 13.2°C in one hour. When we remember that this liberation of heat goes on incessantly, we realize to a certain extent the tremendous store of potential energy contained in radium.

ACTINIUM

In 1899 Debierne separated the radio-element known as actinium from uranium minerals. Neither its spectum nor its atomic weight have as yet been determined. The rate of transformation of actinium is probably very slow, since actinium preparations retain their activities unimpaired for considerable periods. It is apparently a disintegration product of uranium, and occurs in extremely small proportions in all uranium minerals. It is separated with the rare earths and is finally obtained associated with the lanthanum.

ACTINIUM PRODUCTS

The radioactive products of actinium taken in order are radioactinium, actinium X, actinium emanation, actinium A, B, C, and D. Actinium A is isotopic with polonium; actinium B with lead; actinium C with bismith, and actinium D with thallium. Actinium emanation is a gas, apparently inert like the radium emanation, and similarly condenses at the temperature of liquid air.

THORIUM

As mentioned above, the radioactivity of thorium was independently discovered by Schmidt and Curie in 1898. The rate of transformation of thorium has not yet been determined, but it is undoubtedly slower than that of radium.

THORIUM PRODUCTS

The ten successive radioactive disintegration products of thorium which have been identified, taken in their order of production are known as mesothorium I, mesothorium II, radiothorium, thorium X, emanation, thorium A, B, C, C_2 and D. Mesothorium I and thorium X have chemical properties similiar to radium, and are isotopic with it, while radiothorium and thorium are isotopes. The thorium emanation like the emanation of radium and actinium, exhibits the characteristics of an inert gas of the argon family, and is condensed at the temperature of liquid air. Of the remaining thorium products mesothorium II is an isotope of actinium, thorium A of polonium, thorium B of lead, thorium C of bismuth, thorium C_2 of polonium, and thorium D of thallium.

OCCURRENCE OF RADIUM

Radium occurs in all uranium ores, the principal ones of which are carnotite and pitchblende. The former occurs chiefly in Colorado, while there are large deposits of the latter at Joachimsthal, Bohemia. Besides these there are a great many other ores occurring in smaller quantities, among which are Autunite, Chalcolite or Tobernite, Monazite, Thorite, Orangite, etc.

RADIUM—URANIUM RATIO

The striking thing about all uranium ores is the constant ratio of the radium to the uranium content. For a number of years it was thought that carnotite had a low radium uranium ratio, and hence a lower price was paid for it. In as much as the chief source of radium today is carnotite, it was of interest to the U. S. Bureau of Mines to determine whether or not this was true. The work was undertaken by Lind and Whittemore, who came to the conclusion that the ratio for carnotite was the same as for the other ores, and that the low ratios are obtained if the work is not done on large enough samples of ore. They worked chiefly on ton and carload lots.

OF SPRING WATE RADIOACTIVITY

Low ratios are also found at times due to the fact that the leaching of the radium from the ore takes place fairly readily, a fact which is evidenced by the radioactivity of spring water. The latter is of course largely due to the radium emanation, but also in part to the actual radium content.

EXTRACTION OF RADIUM FROM PITCHBLENDE

The uranium is first extracted from the pitchblende, after which we have remaining the pitchblende residues from which Mme. Curie extracted the first radium. These consist chiefly of the sulphates of lead and calcium, together with the oxides of silicon, aluminum and iron. They also contain greater or less quantities of nearly all the metals (copper, bismith, zinc, cobolt, manganese, nickle, vanadium, antimony, thallium, the rare earths, niobium, tantalum, arsenic, barium, etc.) They are first treated with boiling, concentrated sodium hydroxide solution, washed with water, and digested with hydrochloric acid. Much of the material is removed in this operation, the radium remaining in the undissolved portion. After further washing, the residue is boiled with a concentrated sodium carbonate solution which converts the alkali-earths to carbonates. The residue is again washed to remove all traces of sulphates, and is then treated with hydrochloric acid, which dissolves the barium and radium together with certain of the other constituents. The solution of the chlorides is further purified until a salt is obtained containing only barium and radium. The mixed chlorides of barium and radium are subjected to a long series of fractional recrystallizations, the radium being concentrated in the least soluble portion of the fractions. In this manner a pure chloride of radium is ultimately obtained. The concentration of radium proceeds more rapidly if the recrystallization is carried on with the double bromide, because of the greater difference in solubilities. By the latter method, a fairly pure product can be obtained by about six recrystallizations.

EXTRACTION OF RADIUM FROM CARNOTITE

The method used by Parsons, Moore, Lind, and Schaefer to extract radium from carnotite is as follows: The ore is decomposed by nitric acid, and barium chloride is added to the solution in the proportion of two pounds of barium chloride to one ton of ore. The radium barium sulphate is then precipitated by sulphuric acid and the sulphide is reduced with carbon to the sulphide. The sulphide is dissolved in hydrochloric acid and the radium barium chloride is subjected to fractional crystallization. (Bureau of Mines, Bull. 104, page 30, 1915).

References: Radioactive Substances and their Radiations, by E. Rutherford, Cambridge Univ. Press. 1913; the Chemistry of the Radio-Elements, by F. Soddy, Longmans, Green and Co. (second edition) 1915.

METHODS OF DETERMINING THE RADIUM CONTENT OF MINERALS

By Dr. Frank E. E. Germann, Colorado School of Mines

In the preceeding article on radioactivity, the method of extracting the element from the minerals have been explained in detail, and the electric method of determining the radioactivity referred to. As explained there, there is a constant ratio between the radium and uranium content of any mineral when tests are made on ton lots. We may therefore take the uranium content as a fairly positive indication of the amount of radium present, and refer all our tests to it.

If we are able to recognize the mineral at hand, we may immediately find the approximate percentage of uranium present from the following table, which is taken from "Browning's Introduction to the Rarer Elements," page 137.

Uraninite (pitchblende), UO_3. UO_2. PbO. N, etc, contains 75-85 per cent (UO_2xUO_3)

Broeggerite, see Uraninite, contains 76-79 per cent (UO_2 UO_3)

Cleveite, see Uraninite, contains 66 per cent (UO_2. UO_3)

Nivenite, see Uraninite, contains 67 per cent (UO_2 UO_3)

Thorianite, ThO_2. U_3O_8, contains 12-25 per cent U

Gummite, (Pb,Ca) $U_3SiO_{12}.6H_2O.^7$, contains 61-75 per cent UO_3

Thorogummite, UO_3. $3ThO_2$. $3SiO_2$. $6H_2O$, contains 22-23 per cent UO_3

Pilbarite, PbO. UO_3. ThO_2. $2SiO_2$ $2H_2$ O $2H_2O$, contains 27.09 per cent UO_3

Machintoshine, UO_2. $3ThO_2$. $3SiO_2$. $3H_2$, contains 21-22 per cent UO_2

Uranophane, CaO . $2U_3$. $2SiO_2.6H_2$, contains 53-67 per cent UO_3

Naegite, silicate, contains 28-29 per cent UO_2

Uranospaerite, $(BiO)_2U_2O_7$. $3H_2O$, contains 50-51 per cent UO_3

Carnotite, K_2O. $2UO_3$. V_2O_5. $8H_2O$ contains 62-65 per cent UO_3

Torbernite, Cu $(UO_2)_2P_2O_8$. $8H_2$, contains 57-62 per cent UO_3

Zeunerite, Cu $(UO_2)_2As_2O_8$. $8H_2O$, contains 55-65 per cent UO_3

Autunite, Ca $(UO_2)_3P_2O_8$. $8H_2O$, contains 55-62 per cent UO_3

Uranospinite, $Ca(UO_2)_2As_2O_8.8H_2O$ contains 59-60 per cent UO_3

Uranocircite, $Ba(UO_2)_2P_2O_8$. $8H_2O$, contains 56-57 per cent UO_3

Jonannite, sulphate, formula doubful, contains 67-68 per cent UO_3

Uranopilite, CaO . $8UO_3$. $2SO_3$. $25H_2O$, contains 77-78 per cent UO_3

Uranochalcite, see Uranopilite, contains 36 per cent $U_3.O_4$

Zippeite, see Uranopilite, contains 13-14 per cent U_3O_4

Voglianite, see Uranopilite, contains 12 per cent U_3O_4

Uranconite, see Uranopilite, contains 66-71 per cent U_3O_4

Thorite, $ThSiO_4$, contains 1-10 per cent UO_3

Phosphuranylite, $(UO_2)_3P_2O_8$. $6H_2O$, contains 72-77 per cent UO_3

Troegerite, $(UO_2)_3$ As_2O_8 . $12H_2O$, contains 63-64 per cent UO_3

Rutherfordite, UO_2CO_3, contains 80-84 per cent UO_3

Uranothallite, $2CaCO_3$. $U(CO_3)_2$ IOH_2O, contains 35-37 per cent UO_2

Liebigite, $CaCO_3$. $(UO_2)CO_3$. $2OH_2O$, contains 36-38 per cent UO_3

Voglite, complex carbonate, contains 37 per cent UO_2

Hatchettolite, $R(Nb, Ta)_2O_6$. H_2O contains 15-16 per cent UO_3

Fergusonite, $\overset{III}{R}(Nb, Ta)$ O_4, contains 0-8 per cent UO_2

Sipylite, complex niobate, contains 3-4 per cent UO_2

Samarskite, $\overset{II}{R_3}$ $\overset{III}{R_2}$ $(Nb, Ta)_6O_{21}$, contains 10-13 per cent UO_3

Nohlite, see Smarskite, contains 14 per cent UO

Vetinghofite, see Smarskite, contains 9 per cent U_2O_3

Ainneroedite, complex, contains 16-17 per cent UO_2

Hielmite, complex, contains 0-5 per cent UO_2

Euxenite, $\overset{III}{R}(NbO_3)_3$. $\overset{III}{R_2}(TiO_3)_3$. $^3{}_2H_2O$, contains 5-12 per cent UO_2

Polycrase, $\overset{III}{R}(NbO_3)_3$. $2\overset{III}{R}(TiO_3)_3$. $3H_2O$, contains 1-19 per cent UO_2

Yttrocrasite, complex, contains 2-3 per cent UO_2

Blomstrandite, tantalo-niobate, contains 23 per cent UO

Xenotime, YPO_4 contains 4 per cent UO_2

The use of an electroscope in the determination of the radioactivity is the most rapid means of estimating the radium content of an ore, but is a method which requires some knowledge of its use in order to be able to get dependable results. The electroscope must be very well insulated, and the results obtained are subject to certain corrections due to the emanation content of the ore. Those interested in this method will find an excellent description of the apparatus, with photographs and methods of applying corrections to the results by Lind and Whittemore, U. S. Bureau of Mines, Technical Paper 88, Mineral Technology 6, which may be had from the Superintendent of Documents, Government Printing Office, Washington, D. C., for five cents.

The usual method of determining the uranium in an ore is briefly as follows: Treat one gram of the ore (or more if very low grade) in an 8 oz. flask with 10 cc. of strong hydrochloric acid and 5 cc. of strong nitric acid. allow to simmer gently over a low heat until the solution is complete as possible and then boil to dryness. Then add 3 cc. hydrochloric acid and 5 cc, of water, warm for a short time, dilute with 25 cc. of hot water and filter, washing with warm water.

Pass hydrogen sulphide into the liquid to separate the copper, lead, and other metals of this group, filter, wash with hydrogen sulphide water, and boil to expel the hydrogen sulphide. Concentrate to 100 c.c. if necessary; oxide with 10 c.c. hydrogen peroxide, and neutralize with dry sodium carbonate, adding a slight excess. Boil till the yellow uranium precipitate dissolves leaving a brown precipitate which is largely iron. Filter and wash the precipitate with hot water, saving the filtrate. Dissolve the iron precipitate in the least possible amount of nitric acid, add hydrogen peroxide and proceed as before, adding the filtrate to the original.

Concentrate the filtrate to 200 cc., add 10 cc. strong nitric acid, and boil to expel the CO_2. Neutralize with ammonia (until a slight precipitate appears) and add 4cc. of nitric acid for each 100 cc. of liquid. Add 10cc. of a 20 per cent lead acetate solution, and enough of strong solution of ammonium acetate to neutralize the nitric acid present and substitute acetic acid for it. The vanadium is thus precipitated as lead vanadate.

Heat the liquid containing the lead vanadate for an hour on on a steam bath; filter and wash with warm water. Re-dissolve the precipitate in the ieast possible amount of nitric acid, and repeat, adding the final filtrate to the one obtained before. Evaporate the united filtrates to about 400 cc., add 10 cc. strong sulphuric acid to separate the bulk of the lead as lead sulphate and filter, washing with cold water. Neutralize the latter filtrate with ammonia and add freshly prepared $(NH_4)HS$ until the solution is yellow and the uranium and remaining lead ore precipitated as sulphides. Warm gently until sulphides settle. Filter and wash with warm water.

Dissolve the precipitate with hot (1:2) nitric acid, add 5 cc. concentrated sulphuric acid and evaporate until the latter is fuming. Cool, take up with water, let the small precipitate of $PbSO_4$ settle until the liquid is cold, and then filter it off, washing with (1:20) sulphuric acid.

There still remains a small amount of alumina, but for rough work we may ignite the above and weigh. If the alumina is to be determined, the method given in "Low's Technical Methods of Ore Analysis", from which the above is taken, may be used.

Knowing the pescentage of uranium present, we may calculate the radium from the radium-uranium ratio, which is

$$\frac{Ra}{U} \times 10_7 = 3.5 \text{ approximately.}$$

In other words an ore containing a ton of uranium metal would contain 0.35 gm. radium.

A good rapid test for a uranium salt is the borax bead test. Fuse a little uranium salt in a borax or sodium metaphosphate bead. When held in the oxidizing flame the latter is colored yellow and when held ni the reducing flame it is colored green.

SOLDIERS IN HOSPITALS NEED CURRENT MAGAZINES

Don't Stop Putting One Cent Stamps on the Periodicals You Have Finished With—They Are Badly Wanted.

Wounded men in hospitals and soldiers in cantonments awaiting demobilization need magazines more than ever, according to reports received by the American Library Association from its camps and hospitals librarians. From the ame source it is reported that the supply of magazines contributed by the public has fallen off materially since the signing of the armistice.

Whenever you put a one cent stamp on a magazine and drop it into a mail box, it quickly gets into the hands of these men, who need this sort of reading matter very much. Every sort of periodical is in demand, so long as they are recent issue. Humorous, fiction, business, literary—every sort of weekly and monthly publication is eagerly read. Trade and technical periodicals are in demand.

It is such a very little thing for anyone to do, just to put a one-cent stamp on the notice which is printed on the cover of every periodical published in America and drop it in the postoffice. The only apparent reason why the supply of these magazines has fallen off seems to be the general impression that all of the men in uniform are to be immediately sent back home. But we shall have a million and more men in camps for many months to come and tens of thousands in the hospitals, and, as the camp librarians point out they have more time for reading and reading is more necessary to their happiness and well-being than it was while all were keyed up to the heights of enthusiasm.

Please send more books to Mr. Herbert Richie of the Denver Public Library for our soldiers at the hospitals. They are badly needed.

'83

...I am pleased to hear that things are going so well at the School. "Long may she wave." Out here we are in a sort of backwater, and if it was not for the increased cost of living and the great difficulty of obtaining supplies, both for working and living, and the continual demand for war subscriptions, we would hardly know that a war was on. I suffered quite a bit of unpleasantness before the United States came into the war, and I have been very proud and happy since that happened....

WM. B. MIDDLETON,
Oct. 26, '18. Ipoh, Perak, F. M. S.

'14

...As I am very anxious to send all the boys I know who are in the Service a Christmas card, I ask that you give any addresses of the men of recent years that I may forward same to them....

T. H. M. CRAMPTON,
Mill Superintendent, Swansea Lease Inc., Swansea, Arizona.
October 27, 1918.

'14

Miss Jane Ann Carper has arrived to make an extended stay at the home of Mr. nd Mrs A. F. Carper, September 25th, 1918.

HONORARY MEMBER

Hon; Jesse F. McDonald, an honorary member of this Alumni, and former governor of Coloado, has changed his address and is now at Leadville, Colo.

Colorado School of Mines Magazine

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After an unavoidable lapse of three months we are pleased to recommence the publication of the School of Mines Magazine. Our aim is to make it a larger and better magazine than has been published in the past, and if possible to make it of more vital interest to the members of the Alumni and students of the School.. With this idea in view we ask for the loyal support of all Mines and ex-Mines men, especially in sending the publication technical articles, articles of interest and personals dealing with the changes of position, promotions or other items regarding Alumni members. Remember that this is your magazine, and that it must have your loyal support, both financially and morally if it is to be maintained in a manner creditable to the Association and the School. The motto above our desk is "Boost the Colorado School of Mines."

A beautiful silver loving cup has been procured by the School of Mines faculty. This cup will be presented at the end of the school year to the senior class student who has made the best scholastic and athletic record. The cup is a magnificient work of art and is of itself worth the extraordinary effort required to secure it.

The annual convention of the Colorado Metal Mining Association was held in Denver January 2, 3 and 4. This was a most important gathering of mining men. We are promised a complete report of the meeting for the next issue.

Facilities at Hand.

The article in this issue regarding the Experimental Plant, by J. C. Williams, wll be found of much interest to many members of the Alumni.. This plant is maintained by the School and is at the disposal of the members of this Association for working out many problems which might otherwise be hard for them to solve. We find there are a number who do not know that this plant is at their disposal. Read the article and be informed as to the facilities at hand.

The mine rescue apparatus belonging to the School of Mines was rushed to the Midwest coal mines, near Palisade, Colo., in November when word was received that the mine was on fire. The United States mine rescue car, in charge of Daniel Harrington of the Golden branch of the U. S. bureau of mines, was also sent. The fire was put out and no lives were lost at the mine.

Owing to the late date at which arrangements were made with the printer and to the delay occasioned by waiting for manuscript of some of the articles in this issue, and the sickness of a part of the printing force at a critical time, this issue of the School of Mines Magazine is a few days late. However, our forces are now well organized and we expect to make many improvements in future issues.

Owing to the epidemic of influenza athletic work at the School has not been carried to its full extent. Light practice has been carried on since the close of the football season. The work has been confined largely to conditioning the younger players, however, and the letter men have been devoting their time to their studies in order that they may be well situated when the hoop season gets under way in earnest. Captain Miller has a big field of likely candidates undergoing preliminary training.

CAPABILITY EXCHANGE

A plan is being worked out to handle Capability Exchange. Announcement will probably be made in the February or March issue, when negotiations are completed.—Editor.

Colorado's gold output shows a falling off for last year. So did the world's total, and to such an extent that the falling off has become an international problem.

Intensive Prospecting

By GEORGE O. MARRS, '01.

Intensive farming has obtained a yield of hundreds and even thousands of dollars per acre from lanr that formerly produced scarcely five dollars per acre.

It has become commonplace to read that so-and-so made four hundred dollars per acre from his potatoes last year, or that such and such a peach or apple orchard netted its owner $5000.00 last season, or that the celery crop was not so good this year and will only net about $300 per acre instead of $700. The farmer of fifty years ago would have considered such production not only unbelievable but impossible.

Intensive methods applied to mining bring even greater and more astounding results.

Old Prospector Not Thorough

Hats off to the old time prospector and his mangy burro! They went into the apparent barren and trackless wilds and opened the gateway to boundless wealth. Rarely did the prospector realize the fruits of his great discoveries; usually he died in poverty, alone, friendless, with his 'lode' in the hands of strangers, and he, the prospector, looking, looking, for another bonanza. He opened the road for the mining operator, the capitalist, the farmer, and his work transformed mountain and plain.

His sole asset was an optimism so great as to amount to an obsession.

His knowledge was small. Usually he knew nothing of geology, chemistry, surveying, mining operations, mineralogy or assaying — although he acquired a slight knowledge of rocks and formations by continual contact with them. But think of the untold wealth he passed by; think of the valuable ore he tossed to one side and discarded; think how very little of the surface of his claim he explored. He found some rich float here and there, and possibly in the length of his 1500 feet of claim he dug four or five cuts exposing out crop along what he at once assumed was one vein (and he generally also assumed that the 'vein' had continuous value from one end of the claim to the other and that it grew richer with every foot of depth). This optimistic view of his claim prevented him from doing further accurate prospecting; and here was the fault of his work.

Mine Operator Not an Explorer

The mine operator followed the prospector. He started with one of the outcrops discovered by the prospector, and sank a shaft or ran a tunnel on it. Thereafter practically all development work was done underground. The net result was that the surface of the claim was never prospected.

Need of Thorough Surface Prospecting.

It is safe to say that over 99 per cent of all the mining claims on earth have never been properly explored on the surface, and here is the mission of intensive prospecting. The mineral discoveries yet to be announced by intensive prospecting will far exceed in value the total of all bonanzas heretofore brought to light.

A little calculation will illustrate the point. A mining claim has a shaft down on it say five hundred feet, with some drifting and crosscut work totalling 1000 feet in length. There are seven surface cuts, each about 20 feet long. At best the development work does not amount to more than 11,000 square feet of outcrop exposure, while the surface of the claim contains about 300 x 1500 feet, that is, about 450,000 square feet, not counting the greater surface exposure of most claims due to steep slopes. Less than one-fortieth of that claim has been prospected.

Thirty-nine-fortieths of the claim in virgin ground, unexplored. We might well say that the entire claim is unprospected,—its hidden wealth undiscovered.

The mission of intensive prospecting is to unearth the value of that thirty-nine-fortieths of the claim.

The objection will at once occur, "Even if only one-fortieth of the claim has been prospected, that one-fortieth is the valuable part of the claim, it contains the vein, the rest of the claim is worthless, two or more productive veins would not be very close together." This objection is not sound in either theory or experience. Claims are usually located approximately parallel to the formation, mineralization occurs across or at an angle to the formation; therefore value is much more apt to be discovered alongside of and nearly parallel to the ore already found than along the 'extension' of the 'vein.' Every mining man knows that valuable ore deposits are frequently found close to each other, sometimes the two 'veins' being less than ten feet apart. Who does not know of many instances where a drift was run for some distance on a low grade vein, only to discover later by accident that for forty or fifty feet the drift had been parallel to and only a few feet away from 'high grade'? Many times, too, ore shoots are encountered that are actually broader than they are long (calling the direction of the formation the length.) Often the 'vein' is faulted, or turned, or cut off,—in fact there is only one thing about a vein that can depended upon, namely, that it will out crop and that the out crop, when located on the surface can be followed to indefinite depths. Here is the value of surface prospecting;—all the ore shoots can be located on the surface and their approximate size, location, strike, dip and pitch determined without the expensive blind underground work. There has been enough money thrown away in these blind underground 'travels' to have properly prospected every mining claim in the world.

Where Should We Dig?

How should a mining claim be prospected? Dig a series of trenches across the claim from surface to bedrock so as to expose the formation. For the ordinary claim these trenches should be about fifty feet apart, making thirty trenches to the claim and each trench about 300 feet long. The depth of the trenches will depend on how far bedrock is below the surface; in places only a few inches need be dug away, simply to present a fresh surface of rock outcrop, in other places the trench will be five or even ten feet deep; rarely over ten feet deep for most mining districts. Of course where the soil layer is very thick other expedients will have to be restored to, for example, post hole diggers, diamond or calyx drill, etc. (shallow and easy work for such inplements.) Where the vein outcrops beyond the boundaries of the claim, the surface exploration must be done on the ground containing the apex.

This intensive prospecting has little of the glamorous about it,—it is not romantic, it is work, it is hard work. But the results will surprise the most skeptical. Try it. If only one new ore shoot is uncovered it will pay for the exploration of the entire claim many times over.

Observed Results.

Some illustrations from the observation of the writer will indicate the value of intensive prospecting.

1. At a group of mining claims near Walker, Arizona, during a month of cessation of work a man was put to trenching one of the claims;—he shortly uncovered a gold vein three or four feet wide, ore shoot fifty feet long and of fair value, in a part of the claim apparently worthless and barren looking until the two or three feet of earth covering was removed. Additional trenching near the old shaft on the same claim uncovered a lead-silver vein of fair value within thirty feet of and parallel to the gold-copper vein which was being worked. These two veins were both uncovered at an expense of less than fifty dollars. What a comparison between the cost of the exploration work and the value of the find.

2. Surface trench work on copper outcrops of the Desoto and Blue Bell mines near Middleton, Arizona; and Mayer, Arizona, showed that all the ore bodies encountered in the underworkings appeared in the surface cuts and could have been originally discovered there; these outcrops were as a general rule very barren looking until broken into with the pick; an inspection of the surface cuts (mostly put in after underground work) and of the underground workings shows that much money could have been saved by a little surface 'intensive prospecting'.

3 Copp.er mines near San Pedro, New Mexico, flat veins in sandstone. The relation between deeper work and subsequent shallower work and surface cuts shows clearly the advantage of surface work over blind underground 'feeling around'.

4. Saratoga Mine, near Central City, Colorado, At this mine after the hoisting shaft was about 1000 feet deep and the mine had miles of workings a leaser discovered a nice block of ground on the surface between the two main shafts where men had been walking over it daily for years. A little earth covering is all that kept it from being found and its value extracted long before.

5. At a lead-silver mine in Colorado, flat fissure vein, where the entire exploration work was done by surface cuts at little expense the size, etc., of the ore shoots were quickly determined and the subsequent mining operations went ahead with considerable certainty as to what could be expected underground.

A number of examples could be mentioned of mines in Arizona, Colorado, New Mexico, Alaska and elsewhere. It is current history that after the Homestake Mine had operated for years much of the higher grade material came from new finds near the surface which the deeper workngs indicated from beneath and which could have much more easily been discovered by slight surface work.

Engineering Knowledge Necessary

Although it can be seen from reasoning that intensive prospecting is very desirable and effective it is hard to realize how tremendously fruitful it is until one sees some trenching done. By surveying and platting the trenches, much data is obtained besides the actual discovery of ore; one finds thus the direction of the strata, etc., and the crosscracks give the direction and dip of crossdikes and cross-veins. When the assembly of the entire data is made showing veins, ore shoots, assays, strike and dip of crosscracks, etc. the ensemble is astonishing and there is the feeling of finality and safety; one has the entire history, the whole story, and not just part of it. With such data an engineer can report on the property with considerable confidence and can give a much more intelligent and certain estimate of value, prospective profits and methods to be employed.

Watch Cross-Dikes

In doing intensive prospecting two things must be kept closely in mind, namely; (a) Mineralizing dikes, and, (b) Depth to underground water level.

Ore bodies usually occur near, **but not exactly at,** the intersection of veins and intrusive dikes and the pitch of the ore shoot in the vein is approximately parallel to the line of intersection of the dike and the vein (See article of the writer in Mining Science of January 21, 1909, page 49 et seq.) For these reasons it is highly important to obtain the strike and dip of cross-dikes. The same trenches which give us the location of ore bodies also show the crosscracks and other indicia of the crossdikes and enable us to locate and plat them. When we have mapped the veins, the ore shoot outcrops, with the surface assays, and the dikes, all the mystery is taken out of the situation, and even a layman can see at a glance where the ore is and where it is not, and the engineer can with reasonable safety announce from his data the pitch as well as the dip and strike of the ore bodies.

Underground Water Level

Every mining engineer appreciates the importance of knowing the approximate location of the underground water level because the vein is oxidized all the way between that level and the surface of the ground. This oxidized zone has a far different value from the permanent or stable ore below the water line and the ore there is of manifestly different character. Usually the values are much higher in this oxidized area than throughout the mine below water level. Frequently high values are encountered in this oxidized zone, especially just above the water line, due to leaching downward and reprecipitation. In spite, however, of the leaching effect of the downwerd travelling water,—at the surface (and in fact throughout this oxidized zone) the values are usually higher than in the ores below the water level. Even with such soluble metals as copper the writer has seen ore three feet below the surface carrying three or four per cent more copper per ton than ore from several hundred feet below water level, and this too where the water level was three hundred feet below the outcrop. Underground water varies as to depth with local conditions; near tidewater in Alaska the unaltered sulphides come to the very surface of the ground and the 'oxidized zone' is represented by a layer of iron and copper oxides perhaps an inch or two in thickness; at many places in Arizona and New Mexico the underground water level is several hundred feet below the surface; many mines in Colorado have a water level depth of about seventy feet. It does not always follow the configuration of the surface; the writer observed unaltered copper sulphides ten feet below the surface in a mine in Alaska on the side of a mountain having an almost sheer drop of two thousand feet,—and the same thing is true on a lesser scale, of some mines observed in Arizona and Colorado. A knowledge of the approximate depth to water level is important to determine the total value of the mines; for example, there are some good mines in Boulder County, Colorado, (and in other states too for that matter,) where the entire value of the mine, for gold at least, is in the space between surface and water level, the value of the deeper lying ores being small. Surface trenching gives a knowledge of the formations, the porosity or impermiability of the rocks, the position of cross-dikes, and such other data as makes the estimation of the underground water depth very easy. Usually large flows of underground water follow cross-dikes and a knowledge of the strike and dip of the cross-dikes will give much information as to the position and quantity of underground flow water to be pumped or disposed of.

Card Index the Mine.

Intensive prospecting has another angle. Besides going over the surface with a miscroscrope, so to speak, the property under investigation must be viewed in a broader light than merely looking for what the owner may think it is good for.. A property may be practically worthless so far as the gold it contains is concerned, but may be worth millions as a silver mine; it may contain lead, bismuth, uranium, radium, or other rare metals. Perhaps it hides a veritable fortune in asbestos or mica, or some gem. It may contain salable quantities of iron, iron pyrites, manganese, sulphur; a forest of timber; a hidden quarry of fine building material; limestone; gypsum; oil. It may be crossed by a mountain stream with good situation for development of power; perhaps the claim is good for farming, or for summer homes for tourists.

It is an old story how Leadville, Colorado was successively a gold camp, a silver camp, and later a zinc leader; the silver and the zinc were there all the time but it took men of broader vision than the first prospectors to perceive the silver and zinc fortunes in embryo.

The modern engineer has been criticized, and perhaps justly, for being too narrow and pessimistic. Whereas the old time prospector went to the extreme of seeing values where they were not, the accusation is that the mining engineer has gone to the other extreme of seeing nothing where there is something. Just because the owner or promoter of the property thinks it is very valuable for gold is no reason for us to turn the property down because it is not an auriferous marvel. It is our duty to use our broader education and trained powers of analysis to ascertain whether that property is good for something else.

It will certainly be a remarkable property that has no worth for anything and if it contains no gold or silver may be it is worth something for just trees and rock. A good rule is to have at hand a lot of things property is good for;—one mining engineer has at least two hundred items on his list. It is the duty of the engineer to promote and not to retard development and there certainly never was more need for the genuine upbuilding engineer than there is today.

Intensive metallurgy is allied to intensive prospecting. In an ordinary iron pyrites concentrate from a stamp mill there is a big loss in our modern methods of handling. We practically throw away more than $60.00 per ton of iron and sulphur to get paid for the $15.00 to $20.00 of gold and silver the concentrate contains. With thought and investigation, some use might be found for the clean washed silica from the concentrating tables, for the mica scales that come off from some ores, etc.,—but intensive metallurgy is a subject all by itself.

Dig

Intensive prospecting will open to the world untold riches. The work is simple yet it requires the knowledge of the trained engineer to utilize the work, interpret it and obtain results from it. Here is a field for the new prospector, the man of science who is to astound the world with the uncovering of priceless stores of wealth, "laid up from the beginning of the world." The "pearl of great price" is beneath our feet, is not afar off. It is at home, not abroad. The Belgian Maeterlinck described the quest of the blue bird of Happiness, how search was made all over the world, through past ages and even into the dim future and after an unsuccessful and prolonged and fruitless hunt in agony of spirit, the return home was begun and the great treasure was found in the very home which had been left to begin the great searching.

> "Why that's the blue bird we were looking for. We went so far and he was here all the time."

We need no new fields to explore in foreign lands or inaccessible crags, we need no legislation, no higher prices of metals, no discoveries of new metals; all we need is to dig. Modern practice requires trench warfare. Dig.

IOUX.

There was an old chief of the Sioux
Who captured a paleface or tioux
"Your people," said he,
"Once took care of me,
And now I will take hair of yioux.
—B. L. T.

"Does an automobile help you to forget your troubles," said Mr. Pedestrian.

"Yes," answered Mr. Chuggins thoughtfully, "my other troubles."

The Alumni and the Experimental Plant

By J. C. WILLIAMS, '13,
Ass't Director Experimental Ore Dressing Plant, Colorado School of Mines,

In bringing the Experimental Plant to the attention of the Alumni of the school, it is with two purposes in view.

First—That the alumni may become acquainted with the facilities of the plant for experiment and investigation, and second, that an increased use of the plant may extend its usefulness and so help the school by attracting attention of mining men throughout the country.

It will not be attempted here to describe the plant in detail. Such a description will be found in the School of Mines "Quarterly" for July 1917. It may be said briefly that there are facilities for ore-dressing by means of jigs, tables, vanners, flotation machines, electro magnetic and electro-static machines, with the proper equipment for preparing feed for these machines. Tests may be made on lots ranging in size from a few pounds to a car load. By working at first with a few pounds data may usually be obtained which will direct to a large extent, procedure when working on a commercial scale. This point was strikingly borne out in the case of some experiments recently performed at the plant by an alumnus, who, by reason of data obtained by using some of the laboratory equipment of the plant, was able to correct certain defects in the flow sheet of a large Colorado mill, with the result that a large saving was made by the company.

In addition to the ore dressing machines there is a well equiped chemical laboratory, where both wet and fire assays may be made. This should be particularly useful to anyone interested in certain lines of chemical investigation, and who has not acess to a laboratory.

During the past year a number of alumni have taken advantage of the opportunity to do work of an investigational nature at the plant, but there must be many others whose attention has not been called to resources they may avail themselves of, who would welcome a chance to work there.

Except where the school makes a direct outlay for such items as power, labor, orsupplies, the expense to an alumnius working at the plant is nothing. The courtesies of the plant are extended to the alumni with a cordial invitation to use the plant whenever possible. Anyone considering doing any experimental work at the plant should come to Golden and look over the ground if convenient. If it is not possible to come it may be that the work may be performed by the members of the plant staff. Usually for work of this kind there is a small charge as for example when assays are to be made.

Space is reserved at the plant for the use and set up any kind of machine or devise desired. In some special cases it is advantageous to experiment with variations or adaptations of standard machinery or even to use a new devise altogether; this reserve space allows that to be accomplished.

Where the party using the plant makes his own analyses and does his onw work or furnishes his own help, the plant makes no charge except the actual cost of supplies and chemicals used.

The Experimental Plant asks the support and cooperation of the Alumni. It is to our mutual advantage.

Miscellaneous Faulty Expressions in English

A new edition of this valuable set of notes by Dr. Victor C. Alderson has recently been published by F. B. can furnish you with copies.

No Thanksgiving Game

Because of a fresh outbreak of influenza, the football game between the Miners and Creighton university was cancelled. The game was to have been played at Omaha on Thanksgiving day.

MARKET PRICES
December, 1918.

Aluminum	33c per lb.
Copper (electrolytic)	26c per lb.
Iron (Pig)	$36.60 per ton
Lead	5½c per lb.
Nickel	45c per lb.
Palladium	$125 per oz.
Platinum	$105 per oz.
Silver	$1.015 per oz.
Steel	$46.00 per ton
Tungsten	$17.00 to $22.00 per unit
Zinc	7½c per lb.

With The Boys "Over There."

Bravery Under Fire

Gassed in battle during an attack of his company on the Hindenburg line, Captain Lawrence Brown, an ex-Mines man of the class of '18, woke up in a French hospital one day in November to find that he and his entire company had been commended for extraordinary bravery under fire. Captain Brown was in command of a company in the 117th infantry and had taken part in some of the heaviest fighting during the closing months of the war. Just before leaving for France, Captain Brown was married in Golden to his divorced wife, Eileen Brown.

Mines Man in the Air

The many friends of Lieutenant Leo (Joe) Dawson, a former popular School of Mines man of the class of '18, will be interested in reading the following letter from him written to Mr. and Mrs. E. A. Phinney of Golden:

"We are working very hard just now and have been at it for so long that we are all nearly dead. After finishing up the Chateau Thierry drive, we came up near here and went through the drive on St. Mihiel, where the American doughboys did sure beautiful work. Then we were moved over here to our present camp and are in the midst of the American drive, between the Meuse and Argonne forest. So we have been in a constant attack for over three months.

"During a drive the enemy concentrates his air force in proportion to his infantry, so you see what flying over a drive means—many, many hours in the air and a fight nearly every day. My squadron has the most huns of any chasse squadron on the front now (that is Amex of course), totalling 44 official and about 25 unofficial. Our casualties have been heavy, but they have produced results. My puny little score has been boosted up a little, as I've gotten a hun two-seater and a single seater, and a balloon while on this front. That gives me five, three of which are official. Two are not, but they are just as dead as the official ones; just happened to land too far in hunland.

"My last fight was too funny. Four huns (Fokkers, the best hun fighters) jumped a lone American over in hunland and were chasing him straight down. When the yank got to within 200 feet of the ground he flew for our lines as hard as he could come, crossed no man's land and over our trenches. The four huns were so intent on killing him that they forgot to look up (a very careless error) and so came on clear over on our side. Four of us watched them pass under us, and just as soon as they had gone far enough on our side for us to drive between them and the lines, thus cutting off their retreat, down on them we piled. I picked out one and never opened fire until I was within 50 yards of him. As I did he looked up and the despair in his face was too comical. I chased him around over hills, across forests and down the valleys about a hundred feet up in the air and right on his tail all the time. I wanted him to land, but he kept on, so finally he made a quick turn and ran for hunland, so I bore in on him and knocked him down. He fell in no man's land, dead as a door nail. Damn him, I wanted that plane, and if he had only landed on our side I never would have shot him at all. Just a case of poor bean work on his part.

"At last we are being issued everything in the world we could desire, sweaters, fur gloves, fur-lined coats, teddy bears and everything — very nice.'

'15

"Have been here in the service of Supply for the past six months constructing highways. W. F. Koch, '11, is in the same company and D. C. Dodge, '15, is at A. P. O. 767. Met Hornbuckle, (Ex. '14) in Bordeaux but he has since departed for parts unknown. Mines must be well represented in the A. E. F."

G. H. GREENWOOD,
Co. M, 23rd Engineers, A. E. F., A. P. O. 705, France.
Sept. 16, 1918.

'09

...Everything is well with those of us from the Mines in this Company, namely Hazelton, Fagan, and Eyeman. Banks and Duggleby left us to go the Officers Training Camp. There are several Mines boys in the other companies of this regiment but I haven't seen any of them lately. We've been up amidst the fireworks continuously for the last six weeks now and have seen some interesting and exciting times. Altho we're a mining regiment, we do most anything. Have been building bridges lately, following the drive right up and replacing bridges blown up by the Huns as they depart in haste. They are still departing up ahead here, and are going to continue to do so from the looks of things in this vicinity. This is rather a hard life at times and we find much to interfere with our comfort and peace of mind, but if I ever get back I wouldn't have missed it for Coor's brewery.

Yours truly,
W. E. CANNING,
Co. A, 27th U. S. Engineers, 1st Army, A. E. F.
October 28, 1918.

'16

Charles Vorck, a former Mines man, now with the 115th Engineers in France, has been recommended for an officers training school and has been sent to one in France.

ATHLETICS

After a heated discussion lasting nearly twelve hours, delegates attending the annual Rocky Mountain conference on January 4, unanimously voted to admit all S. A. T. C. students to full athletic standing in the mountain colleges. The conference, after adopting schedules for basketball, baseball, track and football for 1919 and changing a few minor regulations governing the sports, adjourned. We have not room in this issue of the Magazine for the full program of sports for 1919, but hope to give it in full in the February issue.

At a meeting of the football men on December 18th Ernest Bunte was elected Captain for the 1919 squad. Bunte is a third year man. He played end on this year's champion eleven and was one of the mainstays of the team.

MINERS DEFEAT D. U. GRIDSTERS 48 to 6.

The husky Miners took sweet revenge on November 2 on the Denver University football eleven for the drubbing given the Silver and Blue last year, and when the smoke of the grid battle cleared away, the Miners had the long end of a 48 to 6 score. Denver's only score came after McLaughlin grabbed up the ball after a fumble and ran eighty yards where it was pushed over on the next play.

The Miners completely outclassed the D. U. bunch, as is shown from a urvey of the chart of the game. times, for a 378-yard gain, an compahed with Denves's 52 rushes for 108 yards. D. U. tried 19 forward passes and completed three for 52 yards. Mines attempted 14 and made six for 102 yards. But the Blue attempts were the more direct, whereas the D. U. heaves a big part of the time were merely wild throws. Barron's tribe fumbled more than their opponents, but followed the ball well and recovered most of them. The Mines made 117 plays to 87, and of these 84 were in the Mines territory and 33, more than one-faurth, were inside the D. U. 20-yard line.

Because of the bar plased on publir gatherings, the game was played behind rlosed gates, only the members of the S. A. T. C of the two institutions being allowed to witness the contest. At least that ruling was supposed to prevail but it was noticed that a few fair football rooters were on the stands, and there were a few old timers who would have a hard time to prove that they were members of the S. A. T. C

The game was played in a sea of mud, and was far from a finished exhibition, because of the mud and also because it was the first game of the season.

One of the big features of the game was the work of George Dunn, for the Miners. Dunn, who is a Golden boy and a star basketball and baseball player, donned the football moleskins for the first time this year. Lack of football experience did not seem to make any difference, however, and Dunn played quarterback like a veteran, and handled the team in a manner that his name is going down in School of Mines football annals on the same page with the names of Ball, and Hoyt, and Harper and Burris and other famous quarterbacks who have worn the Silver and Blue. Pittser, Coulter, Mechin and Fahey, also distinguished themselves by their stellar playing. In fact, the entire Mines team played excellent football.

MINES DEFEAT TIGERS

In spite of their threats that they would claw the Miners, the husky Colorado College Tigers were dynamited by the Golden Miners Nov. 9th on the Union Park football field, and when the smoke of the battle cleared away, the vaunted Tigers held the short end of a 48 to 6 score.

Notwithstanding the overwhelming score by which the Springs boys were defeated, the game was interesting to watch from start to finish. The Miners outclassed the Tigers in every department of the game, and demonstrated without doubt that they were entitled to the championship of the conference.

The bright stars of the Mines team were Dunn, the doughty quarterback, whose generalship and all-around playing brought much applause, Pittser, Fahey, Mechin and Coulter. Every Miner, however, played a star game.

Of the 104 plays made by the Miners, seventy were in C. C. territory and twenty-nine were inside the Tigers' twenty-yard zone. Forty-two of the ninety-nine C. C. plays were on the Mines side of the field, but only five were inside the twenty-yard line. Mines rushed the ball sixty-nine times for 464 yards gain, as compared with sixty-six rushes by C. C, for 138 yards The Tigers were the more adept at recovering fumbles, and the only time they let the ball get away from them cost them a touchdown.

The story of the game is as follows:

The Tigers kicked off and Pittser punted. A 23-yard forward pass by the Tigers, followed by a 14-yard plunge by L. McTavish alarmed the Mines rooters, and the old familiar "Give 'em hell, Mines," was changed to "Hold 'em, Miners." And on their 28-yard line the Miners held and L. McTavish missed a drop kick. After an exchange of punts, in which the Miners gained 10 yards, Smiling Fahey sprinted around right end for 22 yards. Five plays later, Pittser on a delayed pass, squirmed through the center and raced 33 yards to a touchdown. He kicked goal. Mines 7, C C 0.

The Miners next worked their way inside the C C 5-yard line, where the Tigers held. E. McTavish punted to middle field. On the next play Fahey went around right end for 37 yards to a touchdown. Pittser kicked goal, and the score stood Mines 14, C C 0.

Another Mines march, featured by a 20-yard run by Fahey, put the ball on the 5-yard line and on the next play Pittser carried it over. Chance for gaol was missed on the kickout. Mines 20, C C 0

Fahey brought the stands to their feet again with a 37-yard dash, but the Tigers held on their 15-yard line and McTavish punted 67 yards. After an exchange of punts Coie, who had been sent into the C C line-up to relieve L. McTavish, tried to catch Pittser's bounding kick. He fumbled and Epeneter recovered. Coulter and Pittser carried the ball on the next two plays, the latter going over for touchdown. Goal by Pittser, Mines 27, C C 0.

Toward the latter part of the period, Coulter broke through and blocked a kick. A Tiger was caught holding on the play and the ball went to the Miners on the one-foot line. Fahey took it over on the second try. Goal by Pittser. Mines 34, C C 0. The half ended with the ball in the Tigers' possession on the Mines 17-yard line.

The Tigers came back strong in the second half, and even a 50-yard sprint by Coulter around left end and followed by Pittser's 15-yard plunge did not take the pep out of them. Earl McTavish returned the next kick-off 22 yards. A forward pass, L. McTavish to Briggs, netted 20 yards and the Miners were penalized 15 yards. From the center of the field the Black and Gold started a drive that resulted in their only score. With Earl McTavish, their lion-hearted fullback, doing most of the work, they hammered their way down the field to a touchdown. Goal was missed. Mines 41, C C 6.

The final period found the Mines team composed almost entirely of substitutes. Acting coach Sinton, of the Tigers, also had been lavish in the use of substitutes. The first Mines drive was halted by the intercepting of a forward pass on the 5-yard line. Twice the Miners lost the ball on fumbles, only to get it again by stealing an aerial flip. C. C. held for downs on the 25-yard line, but was forced to punt. It took the Miners six plays to score a touchdown. Haskins carrying the ball over after Hopkins and Fahey had put it within scoring distance. Hopkins kicked goal, Mines 48, C C 6. The game ended as C C intercepted a Mines pass on the Tigers 22 yard line.

DEATHS

J. C. Adams, a former School of Mines student, died in Denver, October 26th, of appendicitis. After leaving the school he engaged in the stock business in Routt county, and later became connected with the American Commercial company. He leaves a widow and a small daughter.

After a brief illness with influenza, which developed into pneumonia, Edward J. Dittus, one of the best known men of the Colorado School of Mines, died in Denver, October 11. He had reached the age of 31 years.

Dittus was stricken with influenza while at his work in Alliance, Neb. He was rushed to a Denver hospital where pneumonia developed, death following in a short time.

Deceased was born in Old Fort, Ohio, in 1887. He spent most of his boyhood in Michigan. After leaving the high school he entered the University of Wisconsin. Later he attended the U. S. Naval Academy and then decided to become a Mining Engineer. He came to Colorado and enrolled as a student at the School of Mines, graduating from this institution in 1911. During his last year in Mines he was a Fellow in metallurgy, and when school opened in 1912 he was appointed to the faculty as instructor in metallurgy. After holding this position for several years he resigned to take up practical metallurgical work, and at the time of his death he was chief metallurgist for the J. T. Burns Potash company at Alliance, Neb. He was athletic director at the School of Mines in 1914.

Dittus was a member of the Golden Lodge of Masons and that order conferred Masonic burial rites October 14th. Interment being at Fairmount cemetery, Denver. He is survived by his widow and a daughter two years of age.

Lieutenant Sam Hodge, a former School of Mines student, died of pneumonia in France on December 4, according to a wire received in Denver by his father. Lieutenant Hodge attended the School of Mines in 1901.

Malcolm M. Stuart '08- died in Butte, Mont., Monday, October 28, 1918. He was 36 years of age and is survived by his wife and six-year old daughter. "Mac" was a son of Judge and Mrs. P. B. Stuart, formerly of Denver and a graduate of the School of Mines of the class of 1908. He had been employed at Butte, for six years prior to his death in the capacity of Mining Engineer with the Elm Orlu company. Interment was at Butte. The widow and daughter have returned to Golden to make their home with relatives.

Mrs. Mildred M. Packard, wife of Dr. L. A. Packard, athletic director of the School of Mines, died in a Denver hospital on December 16th, from effects of influenza. Mrs. Packard was a noted singer and a favorite with the students of the school. All were greatly grieved at he news of her death and deeply sympathize with the bereaved husband, who, with a son four months old, is left to mourn the departure of a loved companion.

(From Silver City Independent)

A death which came as a distinct shock to his friends was that yesterday afternoon at 1:50 o'clock at Hanover, of Charles Fay, assistant superintendent of the Empire Zinc Company, who passed away there after a brief illness with pneumonia, which followed an attack of influenza.

The death of Mr. Fay is particularly sad, since he leaves a young widow and a baby but two weeks old. Mrs. Fay, before her marriage was Miss Margaret Sheridan, daughter of Mr. and Mrs. Joe E. Sheridan of this city. Their marriage occurred less than two years ago. Mrs Fay is only now convalescing from a severe attack of influenza and the shock of her husband's death has prostrated her.

Mr. Fay was one of the most popplar employes of the Empire Zinc Company's large staff at Hanover, and prominent in engineering circles, being a mining expert with a bright future before him. He was 29 years old and an honor graduate of the Colorado School of Mines at Golden.

MARRIAGES

A wedding of much interest to Mines men and one which caused considerable surprise to the friends of the young couple, occurred at Indianapolis on October 5th, when Miss Charlotte Hugo, formerly of Golden, became the bride of Lieutenant Neil McNeil, a former Mines student. The bride, who is a charming and talented young lady, lived in Golden a few years ago. She attended the University of Colorado and was a member of the Pi Beta Pi Sorority. Lieutenant MacNeil is from Brush, Colo. He graduated from this school in 1914 and is a member of the Sigma Nu fraternity.

Gilmore S. Davis, a former School of Mines man, and Miss Mary Stuart Hendricks, were recently married in Kansas City. They will make their home in Trinidad, Colo.

Friends of Captain Arthur Kinsley. former School of Mines man and officer of Company A of the Colorado Engineers, will be interested to learn of his marriage just before leaving for France to Miss Eugenia Campbell of Colorado Springs. The wedding took place at San Diego, California, while the Engineers were stationed at Camp Kearney.

PERSONALS

Edwin H. Platt ('00) is on the Western Slope in Colorado on business.

'12

C. H. Reed, '12, is now engineer for the Primos Exploration company at Empire, Colo. Address in care of the company.

Ernest Geary, a former School of Mines student was in Golden in November visiting old friends at the School. He recently returned from Canada.

Archie Spring, a former Mines man and a football star, was in Golden during holiday week visiting friends at the school. He was a second lieutenant in the artillery and received his discharge a short time ago.

'01

W. H. Coghill, '01, spent the month of November in Colorado on consulting work.

John G. May ('01) is practicing his profession in Denver. He missed army service by only one day. He was to have left for camp when the war stopped.

Capt. Geo. B. Clark ('01) has just returned to Denver from the U. S. army, where he was enlisted with the Engineers.

'18

Arthur Swanson left about the middle of November for Texas, to take a position in a big graphite mill near Dallas.

Lieut. Norman Copeland was in Golden during Christmas week visiting old friends and school associates. He had just returned from France where he was in the army aviation service.

Herman W. Hugo ('13) is at Oakes Home in Denver. He is improving and would be glad to receive visitors between the hours of 10 a. m. and 12 m. Don't visit him in the afternoons.

Lieutenant Earl Bilheimer, a former School of Mines man, now a flying instructor at Ellington Field. Houston, Texas, spent the Christmas season in Golden at the home of Mr. and Mrs. E. A. Phinney.

Mrs. Edward Cowperthwaite and little daughter from Warren, Arizona, have been spending a few weeks in Golden visiting Mrs. Cowperthwaite's parents, Mr. and Mrs. John Jeuck.

Mr. and Mrs. Charles F. Oram take pleasure in announcing the arrival of Charles Ford Oram, Jr., on the 26th of November, 1918.

'04

George J. Wackenhut is now at Bisbee, Arizona, Box 2484.

'16

After a short visit in Golden during the holiday season Murray Garrison and bride left for Butte, Mont,, where Mr Garrison. will take the position he was holding before entering the aviation service, from which he was recently discharged.

'11

Irving Williams, accompanied by his wife and little daughter, visited in Golden in December. They were on their way to Corea where Mr. Williams has a position. He was graduated from the School of Mines in 1911 and has been engaged in mining at Anaconda, Mont., for several years past.

Arthur K. Gilbert ('06) has been promoted to the position of assistant superintendent of the acid department of the Western Chemical company at Denver, Colo.

Prof. Harry J. Wolff ('03) has just returned to Golden from an arduous professional trip where he had an experience with snow shoes, intense cold, and other experiences incident to a mountain trip in midwinter.

Fred C. Steinhauer ('99) has charge of the Mountain Park system of Denver, Colo., and west to Mount Evans. He has done some wonderful engineering work on the system and made a permanent name for himself as well as Denver.

William H. Ellis ('02) has gone to the bad. He is practicing real estate in Denver, Colo.

Orvil R. Whittaker ('98) is in the East on professional business.

Percy H. Barbour ('98) recently visited Denver and Golden. He is engaged in the practice of his profession at Georgetown, Colo.

A baby girl was born to Mr. and Mrs. H. G. Grauting at Warren. Arizona, October 26th.

Prof. Ziegler made a business trip to Agra, Oklahoma, December 17, returning December 24.

Ronald Coulter spent the holidays visiting in Harrisburg, Pennsylvania.

President Alderson and Prof. Germann made a business trip to Leadville December 26.

A Chinese student named Chao had his hands severely burned Dec 22 when an alcohol lamp exploded in one of the School of Mines laboratories.

William Charles recently received his discharge from the service. He had completed the aviation course at Berkeley, and when peace came was in training for a commission as an observation officer at the Fort Sill, Okla., aviation field.

S. A. T. C.

For the few months past the Colorado School of Mines has assumed the appearance of a military institution. In September a contract was signed with the U. S. government for the reception of about 200 members of the Students Army Training Corps. It was the intention of the government to erect a large mess hall for the accommodation of these students and temporary quarters were found in the Armory and other places near the campus.

The work of the S. A. T. C. progressed nicely but before work was commenced on the building of the mess hall and housing for these students, the armistice was declared and the contract with the school cancelled. The S. A. T. C, wa mustered out early in January and the School resumed operations on a normal peace basis again.

We had expected to give a comprehensive writeup of the work of this department, but circumstances over which we have no control have prevented doing so for this issue of the Magazine.

As Bad as the Flu

The postman brought mother a letter from her soldier boy. She hurried in to read it to father. Near the end of the letter the son said, "We have ten thousand cases of Bevo in camp now."

Isn't that awful father?" she said; "I'm so afraid he'll catch it. I do hope he can come home soon.

An Irishman meeting an acquaintance and noticing his badly discolored eye, asked who gave it to him?

"Nobody gave it to me," said Pat, "I had to fight like the divil for it."

Two American soldiers were watching with growing surprise the costumes of their allies on a London thorofare. Along came two Scotchmen with kilts and bonnets.

"Tom, look at that; they've even got women in the war!"

"Those aren't women; can't you see they're too tall and broad shouldered."

"They are too, women, I'll bet you a five."

"All right, I'll go you. But how can we find out which is right?"

"I'll go to headquarters and find out."

In a few minutes he returned and greeted his friend with:

"We're both wrong; they're Middlesex Highlanders."

Nervous Operation.

It was the first of the week that the Jinkses, who had fallen heir to considerable property, had been in their new home. Mrs, Jinks was giving a dinner party with the fond hope that from this occasion she would be fairly launched in society.

"Lena," said Mrs. Jinks to her new cook, "be sure to mash the peas thorouhhly to-night."

"What, ma'am," exclaimed the amazed cook, "mash the peas?"

"Yes, that is what I said, Lena, mash the peas," repeated the mistress. "It makes Mr. Jinks very nervous at dinner to have them roll off his knife,"

"The professor was delivering the final lecture of the term. He dwelt with much emphasis on the fact that each student should devote all the intervening time preparing for the final examinations. 'The examination papers are now in the hands of the printer. Are there any questions to be asked?" Silence prevailed. Suddenly a voice from the rear inquired: "Who's the printer?"

A Fair Arrangement.

Smith and Jones were discussing the question of who should be head of the house, the man or the woman.

"I am head of my establishment," said Jones, "I am the bread-winner. Why shouldn't I be?"

"Well," replied Smith, "before my wife and I were married we made an agreement that I should make the rulings in all major things, my wife in all minor."

"How has it worked?" asked Jones.

Smith smiled. So far," he replied, "no major matters have come up".

Please send in Magazine subscriptions promptly.

"What's the matter in there? What are you two children quarreling about?"

Sammy—"Well, he's being mean to me."

"Mean to you? What did he do?"

Sammy—"He hit me before I had a chance to hit him."

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The Rocky Mountain Experiment Station of the United States Bureau of Mines.*

By S. C. LIND, Ph.D., Acting Superintendent.

In 1912, while the late Dr. Joseph A. Holmes was Director of the U. S. Bureau of Mines, the first experimental station in the West was established in Denver, under the direct supervision of Dr. R. B. Moore and of Dr. Charles L. Parsons, Chief Mineral Technologist of the Bureau in Washington. Professor J. C. Roberts was in charge of the Mine Rescue and Safety work of the district, in which service he contined until his resigiation in 1915 to accept the Joseph Holmes Memorial Chair of Safety Mining Engineer in the Colorado School of Mines.

Laboratories and offices were equipped in the Foster Building, Denver, which were enlarged several times during the succeeding four years of occupancy. There were originally four or five members of the staff which has gradually been enlarged and now consists of about 12 regular employees.

The particular investigation assigned to the Rocky Mountain Station was the mining, concentration and metallurgy of the rare metals, especially of uranium, radium, vanadium, molybdenum, tungsten, thorium, mesothorium and others. The first problem undertaken was the utilization of the carnotite of Colorado and of Utah for the recovery of radium, uranium and vanadium. After a field investigation by Dr. R. B. Moore and Mr. K. L. Kithil (U. S. Bureau of Mines Bulletin No. 70), a process was worked out on the laboratory scale for the treatment of carnotite. Among other things, it was found by Lind and Whittemore (U. S. Bureau of Mines Technical Paper No. 88), that the radium : uranium ratio in carnotite is normal. It was also found that the metallic values could be satisfactorily extracted by treating with hot nitric acid (38 per cent). Since Professor Germann of the School of Mines has described this process in the January number of this Journal, no further mention of its details is necessary.

Thru a cooperative arrangement between the U. S. Bureau of Mines and the National Radium Institute of New York, a plant was built in Denver for the operation of the Bureau of Mines' process.

* Published with permission of the Director of the U. S. Bureau of Mines

This plant was operated by the Bureau of Mines at the expense of the National Radium Institute for a period of about three years; during which time 1,600 tons of carnotite containing about 2.7 per cent U_3O_8 were worked. The mining and concentration operations in the Paradox Valley were conducted by Mr. K. L. Kithil and Mr. John A. Davis of the Bureau of Mines. From this amount of carnotite ore, 8,540 milligrams of radium element were recovered in the form of high-grade salts, having a value at present price of over $1,000,000.00. In addition, more than 30 tons of high-grade black oxide of uranium (97 per cent UO_2) were reduced, and about 60 tons of ferrous vanadate containing 30 to 35 per cent V_2O_5. A considerable quantity of the radium produced became the property of the Bureau of Mines, part of which is being used at the present time in Golden for scientific research. About 140 milligrams were presented by the Bureau of Mines to the U. S. Bureau of Standards, Washington, D. C., to be used as radium standards. All the rest of the radium produced is being used therapeutically in hospitals in New York and Baltimore, principally for the treatment of cancer.

Upon the termination of the contract between the Bureau of Mines and the National Radium Institute, the work for which it was established having been successfully finished, the plant in South Denver ceased operating, and has recently been purchased by the Minerals Recovery Company of Denver.

COOPERATION WITH THE SCHOOL OF MINES

In the early part of 1916, the late Dr. W. B. Phillips, then President of the School of Mines, requested the cooperation of the Bureau of Mines, and entered into an agreement under which the Bureau of Mines should move its offices, laboratories and equipment to Golden. This became effective July 1, 1916, since which time the Bureau of Mines has occupied the Engnieering Hall, and has in cooperation with the School of Mines had the privilege of using the equipment of the Experimental Mill, Power House, and part of the time of some space in the Chemical Building.

The cooperative work of the Bureau with the National Radium Institute was brought to a conclusion about a year after moving to Golden. Much of the final refinement of radium by crystallization was carried out in Engineering Hall, as well as all the radium measurements of plant control after July 1, 1916, until the close of the radium plant. Since this time, the attention of the Bureau has been largely directed toward the other rare metals. Altho a quantity of pitchblende from the Gilpin County mines was treated in a cooperative agreement with Mr. Alfred du Pont and Mr. William Wright for the recovery of radium, the mechanical concentration of the pitchblende was carried out in the School of Mines Experimental Mill.

Among other researches in which the Bureau of Mines has been interested, since moving to Golden, the following may be mentioned:

The recovery of mesothorium as a by-product from the treatment of monazite for thorium undertaken in cooperation with the Welsbach Company of Gloucester City, New Jersey, under the direction of Dr. R. B. Moore, assisted by Dr. Herman Schlundt of the University of Missouri. This cooperation resulted in the production of over 100 milligram equivalents of mesothorium and a plant process suitable for continuation of the recovery of mesothorium as a regular part of the thoria industry.

The development of the Caron process for the reduction of manganese dioxide ores containing silver was carried out thru an arrangement with the Bureau of Mines, the Netherlands East Indis Government and the Research Corporation of New York. The experiments on the laboratory scale were made in the technologic laboratory of the Bureau of Mines, and the work on a semi commercial scale in the Power House of the School of Mines. Thru the courtesy of the school, direct connection was made to the large gas producer in order to utilize producer gas as the reducing agent in a modified Wedge funace. The final full size experimental operations were perfected in a 60-foot tube furnace of the cement roaster type at the mills of the Portland Gold Mining Company in Colorado Springs, under he supervision of Mr. G. H. Clevenger of the Bureau of Mines, assisted by Messrs. M. H. Caron, F. H. Mulock and H. W. Young. The process will be established on a large scale by the Dutch Government in Sumatra, and in addition will probably find application to certain Colorado and Mexican silver ores.

During the war, the activities of the Bureau of Mines were largely directed to furthering the production of the so-called war minerals, especially vanadium, molybdenum, tungsten, etc. Considerable work has been done by Messrs. Bonardi, Conley and Yancey on the development of hydrometallurgical processes for some of the less utilized vanadium and molybdenum ores, such as vanadinite, wulfenite, ilsemannite and cuprodescloizite. The processes developed have not yet been tried out on a commercial scale, but it is expected that arrangements for doing so, especially with reference to vanadium, will be made in the near future.

Experiments on the electromagnetic elimination of impurities from pyrrhotite were also successfully carried out by Mr. J. P. Bonardi, assisted by Mr. J. C. Williams of the School of Mines, using the Wetherill separator installed by the Bureau in the School of Mines Experimental Mill. The problem arose in connection with the development of sources of sulfur for making sulfuric acid for war use. The pyrrhotite ore on which the experiments were carried out was submitted by the General Chemical Company from Pulaski, Virginia.

Owing to the interest in zirconium steel for certain war purposes, as well as for general use, the preparation of pure metallic zirconium and a study of its properties were assigned to the Rocky Mountain Station. Dr. J. W. Marden from the University of Missouri, and Lieutenant Malcolm N. Rich of the Chemical Warfare Service have had direct charge of the experiments. An Arsem electric vacuum furnace has been installed in the Power House, and experiments are still under way in the production of the pure metal, as well as a study of the most effcient methods for obtaining pure ZrO_2 and other zirconium salts.

Other recent metallurgical researches in charge of Mr. C. W. Davis that may be mentioned are the reduction of tungstic acid to metallic tungsten, the treatment of low-grade nickel ores from North Carolina and Alaska, and of low-grade bismuth ores from Utah.

At present, an examination in progress is one requested by the U. S. General Land Office of Salt Lake City, to determine the thorium and gold content of the monazite sands of Idaho, with a view to the proper classification of the public lands in which they occur.

Purely scientific investigation at the Rocky Mountain Station had to be largely deferred during the war. Since moving to Golden, however, some experiments have been made by the writer on the chemical effect of radium emanation in producing certain gas reactions. It is expected that these researches will be continued in the future and extended to other gaseous system. Determination was also made by Messrs. Underwood, Whittmore and the writer of the solibility of pure R_2SO_4 in water and in H_2SO_4 solutions.

A cooperation with Professor C. C. Van Nuys of the School of Mines, Professor R. E. Nyswander of Denver University and Dr. R. B. Moore of the Bureau of Mines, in studying the spectra of some of the rare gases was interrupted by the war. It is hoped that these researches can be shortly resumed, and that it will be possible to utilize the splendid Hilger spectrograph of the Physics Department of the School of Mines.

The radium luminous paints made by mixing phosphorescent zinc sulfide with small quantities of radium salts (1 part of radium element per 4000-40,000 parts of Zns, according to the luminosity desired) have been of especial interest during the war on account of their extensive use by the Navy and War Departments. The Bureau of Mines has been interested in the luminous paints and has prepared a small quantity from its radium in Golden. Lack of sufficient staff has hitherto prevented extensive investigation, but it is planned in the near future to begin a scientific study of the production of phosphorescent zinc sulfide and of luminous paint, using both radium and mesothorium. In this connection, some experiments were also made by Messrs. Yancey and Underwood in the recovery of polonium, ionium and actinium from by-products saved in the process of radium production.

For the past several months, Dr. R. B. Moore, Superintendent of this Station, has been assigned to service in the Texas gas fields in the recovery of helium from certain of the natural gases. This is the first attempt to recover helium in large quantities. The purpose is to supply a light, **non-inflammable** gas for war balloons and dirigibles. Three experimental plants have been constructed, under the supervision of Dr. Moore representing the Bureau of Mines, by the three largest liquid air companies of the country. The experimental results justify expectations that helium will now be produced on a large scale for aeronautic application.

It is believed by the writer that the post-war period will witness a great revival of interest in the development of mining, metallurgical and chemical industries. Methods of intensified research, as well as the newly awakened consciousness of our national needs in these directions will work together with the renewal of foreign competition to stimulate research in these fields to a hitherto unrealized degree. It is hoped that the co-opertion of the School of Mines and the Bureau of Mines can be of no little service to these mining and metallurgical industries in the Rocky Mountain Region during this period.

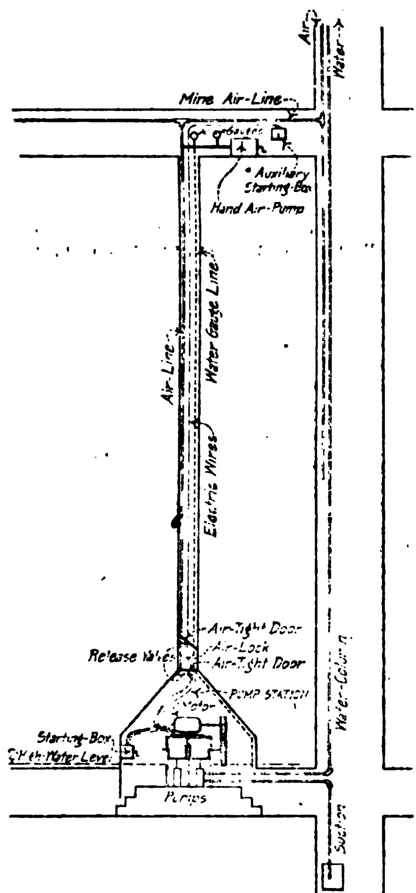
Description of a Non-Drowning Pump Station

By CHARLES ERB WUENSCH, '14

During the unwatering operations at the Yak mine, of the Leadville District, it was noticed that in the backs of several old stopes air-pockets had been formed. Even though the water had risen considerably above the highest points in these stopes, the small cavities in the back were entirely unwetted. This suggested to me the possibility of designing underground pumping stations utilizing the principle of the hydraulic "Diving Bell."

In the history of a great many mines which have been drowned, it is on record that if only an hour or two more time could have been had in which to make the necessary repairs that thousands of dollars of expense of unwatering might have been saved. In the Yak mine, due to a sudden inflow of acid water which ate out the pumps of an intermediate pumping station and caused excessive flow to be handled by the pumps at the bottom, the motors burnt out. (The sudden flow of acid water was due to the Moyer mine, an adjoining property, having been abandoned. There being no underground connection at depth the water, which was formerly handled by the Moyer pumps, backed up through the old stopes and took into solution the sulphates of iron and zinc which had been formed by the exposure of sulphides to oxidation for a number of years, and then the waters charged with these sulphates found their way over into the Yak mine and ate the intermediate pumps away.)

By referring to the accompanying sketch, the general design of this style of pumping station can be readily comprehended. The pumping station is cut out so that the area at the back of the station will be contracted as shown in the sketch. A raise will be driven from the back of the station to the level above. Through this raise the air-line and a water-gauge line and the wires to the auxiliary starting box will pass. There will also be a ladder-way. At the bottom of this raise there will be two air-tight doors forming an air-lock. When everything is running smoothly, these doors will be open and the heated air, which is usually present in the back of a pump station due to the heat of the motors, will pass up the raise and fresh air come in at the bottom. This will have the minor advantage of having the electric motors working in a cooler atmosphere. In case something happens to the motors or pumps, the lower air-tight door is closed, and as the water rises in the mine sufficient air will be admitted through the air-tight door to balance the water pressure due to the raising water. The air may either be obtained from the mine air-line, or if



this is out of order also, the small amount of air necessary can be forced down through a hand air-pump as shown. Two guages are provided; one, a water-guage to measure the hydrostatic pressure of the water in the mine, and the other, to measure the pressure of the air that is forced in the pump-station to balance this hydrostatic pressure.

At the bottom of this raise is an air-lock. Men can go down the raise to the top of the pump-station, close the upper air-tight door, and by releasing the valve in the lower air-tight door they can gradually become acclimated to the pressure; then open the lower air-tight door and pass into the station to make the necessary repairs. It can be seen that the men can work for a considerable time before the pressure will become too great for them to work. The raise can be made large enough so that the various parts of machinery can be hoisted in and out of the pump-station.

When the men are working in the pumping-station under pressure, caustic soda (sodium-hydrate) should be placed about the station to absorb the carbon dioxide which is exhaled.

An auxilliary starter is shown in the sketch on the same level as is the hand air-pump. This is merely used to start up the motor to obviate going down the manway, passing through the air-lock and thence entering the pumping-station, in order to start up the motors when the shutdown was due to power trouble.

Should the ground at the pump-station be fractured it might be advisable to fill the crevices with hydraulic cement. In most cases, however, the air pressure will suffice to keep the water at the desired level.

CAPABILITY EXCHANGE

Arrangements have been made for the Capability Exchange work of Alumni to be handled by The Business Men's Clearing House, Chamber of Commerce Building, Denver, Colo., and The Interstate Business System, Kittredge Building, Denver, Colorado, dividing the orders and inquiries among them on an equal basis.

Any alumnus not already registered with both of these agencies is requested to write at once to CAPABILITY EXCHANGE OF COLORADO SCHOOL OF MINES, Lock Box B, Golden, Colorado, giving full particulars of experience, kind of position desired and any other matter that will assist in obtaining a desirable place and salary, and his application will be at once placed in accordance with the above arrangement with these agencies and the Capability Exchange officers in Golden will push the application.

Such applications from Mines men will be filed and acted on without the preliminary fee of $2.00 which is charged by these agencies as they have agreed to furnish their service to our Capability Exchange without asking for this preliminary fee on applications coming through the Capability Exchange. Mines men placed by these agencies will of course have to pay the same fees as charged to other technical men by such agencies—the only free feature being the $2.00 initial fee .

After several hours discussion it was decided at an informal meeting of all the Alumni available, at University Club, Denver, in December 1918, that it would be better to give the Mines men the advantage of the facilities and lists of the two leading Denver high class Employment Agencies, rather than to limp along with a personally conducted agency depending for clientele entirely on the efforts of one man.

By this arrangement of free registration the Mines men will get the call on all positions open to technical graduates and students. These two agencies give the Mines men the preference and first call on all positions to be filled, and their agency business extends throughout the entire world. They have both placed men in Asia, Africa, South America, Canada, and of course throughout the United States. Both agencies have been established and doing business in Denver for over 15 years, and we believe that between them they represent the majority of technical men placement in the United States, possibly in the world.

Send in your personal record and become registered. There are some high grade positions open now for which Mines men will be first considered. Our Capability Exchange will take a personal interest in watching the progress of your application and keeping you advised. Get in line for a position to better yourself. It costs you nothing unless they place you.

Interesting Experience

"What are you reading there?"

"A book entitled, 'Recollections of a Dry Town.'"

"Rather dull, I suspect?"

"Not as dull as you might think. The subtitle is, 'Some Bootleggers I Have Met.'" — Birmingham Age-Herald.

"He never makes a mistake, because he never comes to a decision."

The Occurrence of Nickel Ore Near the Village of Livramento, Minas Geraes, Brazil, South America,

Abstract of an Artic'e Appearing in March, 1916, Bulletin of the Geological and Mineralogical Service of Brazil, by Horace E. Williams.

——Translated from Portugese by Jose Moraes, '21.——

In the beginning of December, 1915, when Mr. Williams was on his way to Rio Claro, Rio de Janeiro, a Brazilian engineer of the Western Railroad of Minas Geraes, called his attention to some samples of a greenish mineral which he stated came from Livramento, and which he supposed to be copper (Malachite). Mr. Williams obtained permission of the Director of the Service to make a short trip to Livramento to examine the deposit, which was reported to be immense in size. After several days at the property he returned to Rio de Janeiro. The samples were analyzed and found that they did not contain copper, but that they were Garnierite, the hydrous silicate of nickel and magnesium.

LOCATION

Livramento is a small village situated along the Sul Mineira Railroad, 261 kilometers northeast of Rio de Janeiro and about 55 kilometers northeast from the Mount of Italiaya, the highest mountain in Brazil, in Turvo County, State of Minas Geraes. The deposit is situated about 2500 meters northeast of the Livramento railroad station and about 400 meters from the nearest railroad point.

GENERAL DESCRIPTION

The region is an old peneplain. The topography in irregular; sharp cliffs and mountains which attain a height of 400 to 500 meters above the general elevation of the region, are numerous. The mountains and valleys are spaced in a characteristic manner more or less parallel to the Rio Grande which flows through the village. This parallelism coincides in a general way with the geologic structure of the region. At Livramento the Rio Grande is very narrow; to the north and northeast, rivulets and creeks flowing in parallel valleys, join the Rio Grande until its confluence with the Turvo River, whence the course of the river makes a bend, cuts through and exposes the anticlinal structure of the region. All the rivers and creeks in this region are shallow and drain marshy flat valleys.

In this region are also found old gold mines which were worked by the ancient inhabitants of the village.

GEOLOGY

The zone around Livramento consists of gneisses and mica-schists which are intruded by large masses of acid and basic eruptives. The region has been highly compressed, the schists for the most part are folded into a vertical position but have a variable strike, which is more or less parallel to the valley, Pegmatites dikes are frequently found intruding the schists. They are highly altered and large deposits of kaolin are numerous. Black tourmaline and rutile crystals are abundant in the pegmatites. Biotite is of more frequent occurrence in the rocks of the eastern part of the village. In one portion of the area an excellent grade of graphite was found in a small pegmatite vein. The nickle ore (garniernite) is found in the most highly altered (serpentinized) portions of a large intrusive mass of a basic eruptive rock which consists chiefly of olivine.

The chief occurrence of the nickeliferous minerals is found about 2500 meters northeast of Livramento, It occurs along the slope of a small hill, at the extreme edge of which is a very high irregular cliff, and extends for some distance to the southeast. The hill is composed of ferro-magnesium rocks which are highly altered. Crusts of limonite are conspicuous. They appear to have a definite genetic relationship to the serpentization and to the garnierite.

In an unaltered portion of the mass a crystalline greenish-black out-crop, resembling peridotite, was found. Dr. Rimann, of the service, determined it as cortlandtite, a rock composed chiefly of olivine and hornblende amphibole,

One of the open cuts at the contact of the cortlandtite and the mica-schists showed the intrusive character of the former. It was injected into the mica-schists like a series of fingers.

The nickle mineral is found in small veins and pockets of secondary origin in the fractured serpentine. These fractures extend in all directions. In one of the open-cuts a large mass of white talc, tinged a clear green by the garnierite, was found. The mineral was waxy in appearance. In several places the better specimens were several centimeters thick,

Analyses made by Dr. T. H. Lee in the laboratories of the survey gave the following results.

Sample No.	Per cent Nickel
1	0.9
2	3.8
3	8,2
4	15.0

The first sample was of the compact unaltered Cortlandtite, only slightly stained green. In No. 2, the material was of a talcose nature and was stained a clear green color. No. 3. was the same sort of material, but only more deeply green in color. No, 4, same material, but very deep green. From this it can be seen that the more pronounced the color is the higher is the nickel content liable to be.

Sample No. 3 contained nodules of serpentine and magnetite. Dr, Lee found considerable chromium in this specimen. This probably was derived from chromite or piccotite which is associated with the magnetite.

CONCLUSION

Dr. Williams in his conclusion states that in the present state of development because of the overburden it is difficult to tell the extent or value of the deposit. It is, however, a very promising prospect and its geological occurrence is of special scientific interest. Dr. Williams recommends a systematic exploration and survey of the region. The Brazilian Geologic and Geographic Commission have alredy mapped a great portion of the State of Mineas Geraes. The map includes Livramento but it lacks only a short distance of including the region in the immediate vicinity of the deposit. Dr. Williams concludes his article by giving the uses of nickel and the production statistics of Canada and New Caledonia, the chief nickel producing countries of the world.

L'Envoi

Judge, heed this faint encore.
Make worry disappear.
Forget about the war——!
The days of peace are here.

Dodging It

"Hubby, if I were to die would you marry again?"

"That question is hardly fair my dear,"

"Why not?"

"If I were to say yes you wouldn't like it, and to say never again wouldn't sound nice."—Pittsburg Sun.

THE IDLE HOUR COLUMN

Acid Proofing for Concrete

10 per cent Litharge
20 per cent Short-fiber Asbestos
70 per cent Sand.

Mix to consistency of a thin paste with 40° Baume' solution of Sodium Silicate (Water Glass).

* * *

Chief Uses of Infusorial Earth (Diatomaceous Earth)

Sugar-filtering, Victrola Records, Fertilizers, Water Glass, Pigments, Aniline, Fireworks, Dynamite, Paper-mache, Structural Materials, and for Heat Insulation.

* * *

In every invention a great many men contribute toward making it a succes. Often times the real inventor is impractical and it remains for some man with practical ideas to make the invention useful. So it was with the telegraph. Colonel B. G. Jayne, a personal friend of Morse, the inventor of the telegraph, and Ezra Cornell, the founder of Cornell University, is credited with the following account: Through Jaynes' influence Morse received an appropriation of $3000 from Congress with which to build an experimental line from Washington to Annapolis. Ezra Cornell, who at that time was a contractor and builder in the city of Boston, and who was a personal friend of Morse's, was selected by the latter to build a line under his direction. Morse's method was to dig ditches and lay the wire in conduits. They had not gotten but a few blocks when Cornell saw that it would be impossible with the appropriation to make any headway so he told Morse that if he permitted him to he would build the line. He did so by stringing the wires on poles and using the necks of broken bottles placed on wooden pegs for insulators. So by this invention the telegraph was made practical. The wealth derived from this invention laid the basis of Cornell's huge fortune with which he later endowed Cornell University.

* * *

Force Needed to Push Truax Mine Cars

Weight	Grade	Push
3000 lbs.	Level	50 lbs.
2000 "	"	35 lbs.
640 " (Empty)	"	16 lbs. to start
640 " "	"	8 lbs.

In designing furnaces for burning powdered coal allow 1 cu. ft. Vol. for each 3 lbs. of coal burned per hour. 1 cu. ft. powdered coal weighs 38 lbs. Furnaces for coal require 15 sq. feet of grate area for each 100 lbs. of coal burned per hour.

* * *

Properties of Impurities in Iron Ores

1. Silica, requires lime to flux it off.
2. Alumina, causes high fuel consumption to flux it off.
3. Titanium, found especially in magnetites. It is highly refractory and drives the iron into the slag.
4. Manganese, found especially in limonites. Makes slag fluid but is liable to drive iron into slag and consume abnormal amounts of fuel.
5. Phosphorus and sulphur, undesirable because of detrimental effects of sulphides and phosphides in properties of steel.

* * *

Types of Iron Deposits

1. Magnetic Segregations.
2. Contact Metamorphic.
3. Sedimentary.
4. Replacements.
5. Gossan.

* * *

Engineering Data of Vital Importance in Examining a Hydraulic Placer Property.

1. Area and depth of deposit and volume.
2. Average value per cubic yard, and the nature of the gold and by-products, so as to be able to design an efficient type of gold saving plant.
3. Amount of water available and the head or pressure under which it can be obtained so as to estimate the yardage that can be sluiced per day.
4. The length and grade of the necessary ditch lines, pipe lines, etc., for delivering this water under pressure to the giants.
5. The depth of the gravel deposit in its relation to the bed-rock level and to the natural drainage plane of the surrounding country, so as to find out if possible to work the mine, save the gold and dispose of the tailings through a sluice laid at the necessary grade without having to resort to the use of elevators.
6. Make a careful topographical study of the nature of the deposit, in order to ascertain the best location at which to commence mining operations, as in some cases it may be necessary to run bed-rock tunnels to drain the deposit and to admit of discharging the tailings from mining operations into some large river or valley where they will be carried off by the flood.
7. Size of the boulders so as to determine grade of sluices, and if it will be necessary to use a derrick to dispose of them. Character of gravel—is it cemented or not?

—From Joshua Hendy Iron Works Catalogue.

* * *

Chromite is invaluable as a lining for various metallurgical furnaces, because of its neutral character, its high melting point and its indifference to sudden changes in temperature. Being neutral, that is, it is not corroded by either an acid or basic slag, the charge in the furnace may be greatly varied without the danger of corroding the lining or necessitating changing the lining material from a basic to an acid-lining with every change in the charge. In furnaces constructed partly of silica and partly of dolomite or magnesite brick, a band of chromite brick is placed between the two, (acid and basic bricks) to prevent their corroding each other.

* * *

Aluminum Flux

96 parts Borax,
4 parts ($NaH\ SO_4$) Sodium Bisulphate.

Clean surface well and use flux very sparingly.

Sounded Domestic

Gen. C. C. Williams, Chief of Ordnance, said at a Washington dinner party:

"The pluck of our boys is tremendous. If you ever hear anything suggestive of funk on the doughboy's part, you can rest assured that investigation will clear it up.

"'I'd like to volunteer for the infantry, but mother won't let me.'

"'What!' said a listener, 'a big six-footer like you, and your mother won't let you;'

"'No,' said the young man calmly, 'so I've volunteered for mine sweeping.'

"'Mine sweeping? Good gracious; that is more dangerous than infantry fighting by a darn sight.'

"'I know it is,' said the young fellow, 'but mother don't.'"

In No Danger

"I say, Jones, I want to insure my coal-yard against fire. What would a policy for $20,000 cost?"

"What coal is it? Same kind as you sent me last?"

"Yes."

"I wouldn't bother insuring it if I were you. It won't burn."—Boston Transcript,

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Address all communications to Lock Box B, Golden, Colo.

OUTLOOK FOR GOLD AND SILVER

There was approximately nine billion dollars worth of gold in the world before the war, and the debt of the world was in the neighborhood of thirty billions. Assuming now there is not more than eleven billion dollars worth of gold in the world and with the debt of the world amounting to two hundred and fifty billions, it can readily be seen that something will have to be done to stimulate the gold production. The prospects are that silver may have to be monotized to help her sister metal, gold, maintain a safer ratio of reserve. One thing is certain, however, and that is, the price of silver will remain at its present high level for some time.

COPPER OUTLOOK

The reduction of The Anaconda Copper Mining Company's yearly dividend from $8,00 to $6.00 may be considered as the first step toward the readjustment of prices according to the natural law of supply and demand. It is reported that 80 million pounds of copper is available in this country; most of this being either in the process of refining or in storage awaiting marketing. The fact that a provisional settlement of 12 cents a pound is all that copper selling agents are willing to pay producers is strong evidence that there is an oversupply available. A selling price of 12 cents a pound is less than the price of production in most camps because of the high cost of labor and supplies. Consequently it is inevitable that many mines will have to suspend operation temporarily.

To offset this condition the Copper Expert Association have placed a price of 23 cents for copper, but unfortunately there is no foreign market to absorb any of the oversupply. With all industries and businesses waiting for a drop in the prices of labor and supplies before they undertake any new construction work, and with the prospect of reclaiming at least an amount equal to a years' production of the red metal from the salvaging of war-materials and battle fields, it must be truthfully admitted that the outlook is anything but encouraging.

The value of the minerals produced in the United States in 1917, according to the delayed report of the United States geological survey, was $5,010,948,000, an increase of $1,496,-976,000, or about 43 per cent more than the former record—$3,513,972,-000—established in 1916. The blast furnace products (pig iron and ferroalloys), copper, coal, and petroleum, contributed 74 per cent of the total value of minerals produced and 88 per cent of the increase in 1917.

The metals established a new record in 1917, being valued at nearly $2,092,000,000, and representing 42 per cent of the total value of the mineral product. They showed an increase of about $1471,316,000, or 29 per cent over the $1,620,508,000 reported for 1916. The blast furnace products contributed nearly 90 per cent of the total increase, Increases were also made in the value of aluminum, copper, lead and silver, but decreases were recorded in the value of gold and zinc

The value of the non-metallic products in 1917 was 58 per cent of the value of all minerals produced, increasing $1,010,459,000, or nearly 54 per cent, from the former record of $1,878,464,000 in 1916, to $2,888,923.000 in 1917. Of this total increase coal alone represented nearly 66 per cent, and coal and petroleum combined contributed about 85 per cent.

In Colorado there are several non-metals on the shipping list, with coal at the top and potash in prospect.

In this issue appears an abstracted article descriptive of a nickel occurrence in Brazil. Apropos of Mr. Marrs' article in the January issue concerning "Intensive Prospecting," in which he mentioned being on the lookout for unsuspected minerals, this article should be highly suggestive for those engaged (or rather lately engaged) in chrome mining.

Chrome and nickel both are invariable only found associated with the most basic rocks, such as gabbros and peridotites. The writer has observed zaratite, a hydrated basic carbonate of nickel occurring as a green coating associated with chromite ores in California. It is quite possible that some of the chrome deposits, if examined for nickel, might prove to contain it in commercial quantities. The determination of nickel at a custom assay office is just or more expensive than the analysis for chromium, hence it is doubtful whether very many chromite ores have ever been assayed for nickel.

In this connection of rock association do not forget that platinum is also only found in the basic igneous rocks. Platinum can be detected by "panning" because of its superior gravity.

The appropriation of $50,000 asked for the Experimental Plant of the Colorado School of Mines is of special interest and if properly expended will be returned manifold to the mining industry. The building is of ample size for complete experimental apparatus of all descriptions, but as yet the equipment is only a small part of what it should be. An adequate heating plant is an absolute necessity, The present facilities are not available more than two-thirds of the year because of this need. In addition more adequate fine crushing and screening equipment is needed for the preparation of samples ranging from a few hundred pounds to a ton in size. A larger staff should be added and a mature man of wide mining experience appointed to fill the directorship which is now vacant, in order that a well planned, intensive series of urgent metallurgical investigations can be carried out. If the appropriation is diligently expended the work done should make the Colorado School of Mines Experimental Plant of cosmopolitan fame in the mining world.

A CORRECTION

On page 12 of the January issue of the Colorado School of Mines Magazine, mention was made of a beautiful silver loving cup which is to be presented to the graduate of the class of '19 who has attained the best scholastic and athletic record. This cup is the individual gift of Prof. Victor Zeigler. We congratulate Prof. Zeigler on his ingenious innovation to foster that splendid combination, athletics and scholastic activity.

FINANCIAL

The following item with reference to the financial status of the School is taken from the Biennial Report, 1916-1918:

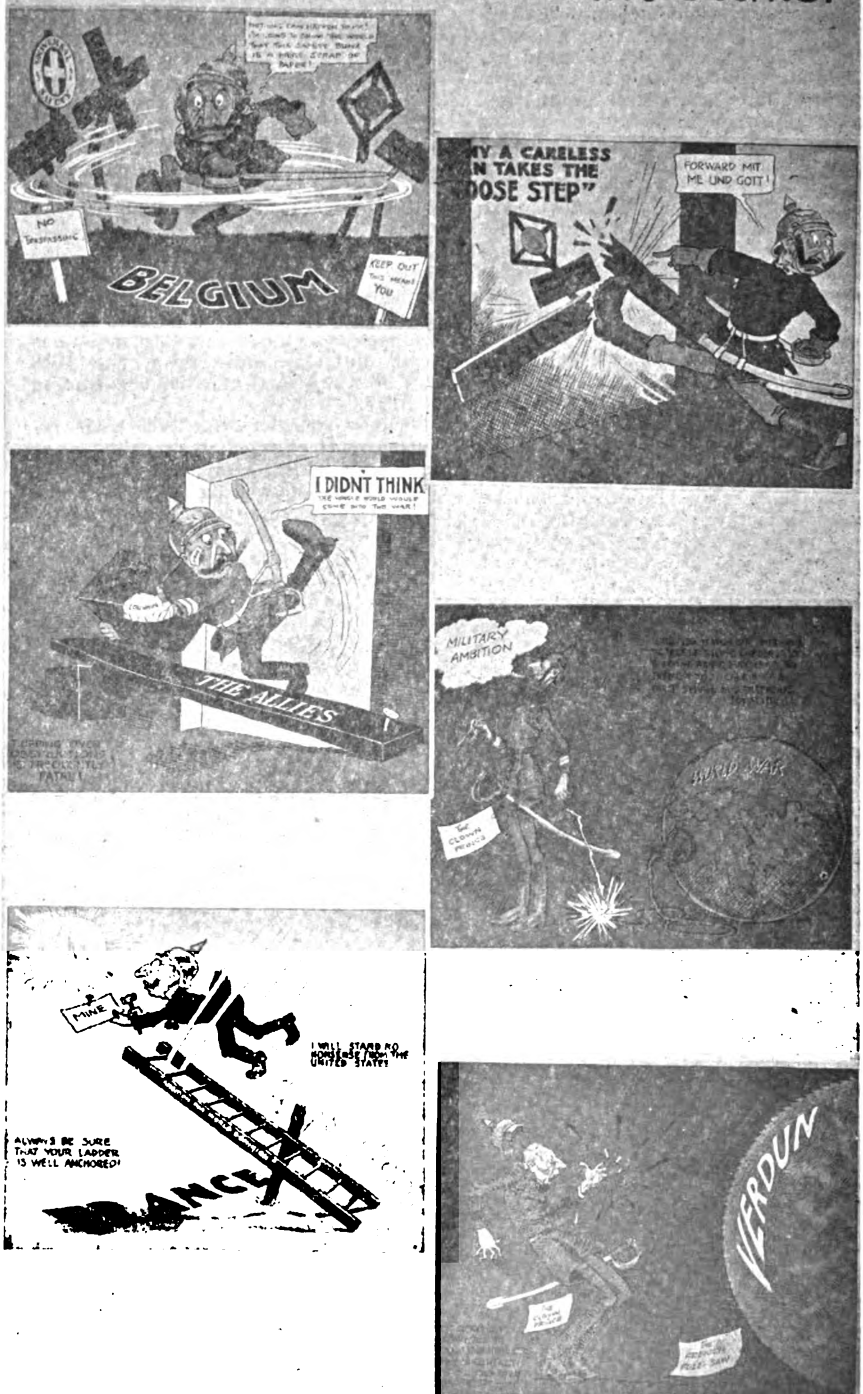
"It is a pleasure to report that the institution is without indebtedness of any kind and has been living wholly within its income as represented by the mill levy and the fees derived from students. This fortunate condition is the result of economies instituted about six years ago, following a period of construction and expansion during which a considerable deficit had accumulated. The past two annual reports, however, have shown cash balances to our credit and the current report also indicates a balance which, nevertheless, is only sufficient to meet our needs until receipts from the 1918 levy become available in the Spring of 1919.

"The accumulation of cash resources has enabled us to add to our permanent improvements and equipment without asking special legislative appropriations and without receiving an addition to the mill levy, such as was granted the other institutions four years ago. In fact, no special legislative appropriation has been available for the School of Mines since the biennial period of 1911-12, and all additions to plant and equipment since that time have been made wholly from our current and accumulated funds. This state of affairs, however, cannot continue indefinitely if the school is to meet its opportunities. Legislative aid will be required to carry out projects which are outlined elsewhere in this report.

In this issue we reproduce on a small scale a "moral in safety" which was gotten out in the form of a calendar by the Council of Universal Safety. We hope that our readers will be "wise" people, for as you know there are three kinds of people. First, fools, who profit neither by their own experiences or the experiences of others. Second, smart people who only profit by their own experiences, and third, wise people who profit by their own experiences as well as by the experiences of others.

The following ad for an educational institution recently appeared in a newspaper: "Enroll now in the B— School of Languages. Day and evening curses." There is a discussion on now between two teamsters in the alley, both of whom appear to be graduates from this school.

THE WORLD'S GREATEST CHANCE TAKER
The Kaiser's Career—In Twelve Scenes.




HE WOULDNT WEAR GOGGLES!
ITALY
AUSTRIA


HA-HA-HA-HA!
SAFETY FIRST
FOR DEMOCRACY"


SEE? IT IS A DEAD WIRE! THERE IS NO DANGER IN IT? MY U-BOAT WILL CUT IT OFF!
America
4000000 in France


PEACE!
PEACE!
BEWARE OF THE DOG


I DONT START IT!
"I DONT THINK!"
"DONT BLAME ME!"
"I DONT DO IT!"


COME ON WILLIE I'VE GOT YOUR PLACE READY IN THE GRAVEYARD

Technical Review

The purpose of this column is to make a brief review of books and articles of interest to the Mining Engineer. It is especially intended for the busy engineer or the one too inaccessibly located to have the use of a complete library.

The various faculty members at the school have generously agreed to contribute abstracts of the most important literature in their respective lines, which they find during the course of their monthly reading. Because of the extra work incidental to the beginning of the second semester the faculty has been unable to contribute to this issue. Subsequent issues, therefore, should be more complete.

U. S. BUREAU OF MINES
New Publications

Annual Report.

Eighth Annual Report of the Director of the Bureau of Mines, by Van H. Manning. 1918. 123 pp.

Bulletins.

Bulletin 156. The Diesel engine, its fuels and its uses, by Herbert Hass, 1918. 133 pp., 16 pls., 57 figs.

Technical Papers.

Technical Paper 192. Production of explosives in the United States during the calendar year 1917, by A. H. Fay. 1918. 21 pp.

Technical Paper 206. Coke-oven accidents in the United States during the calendar year 1917, by A. H. Fay. 1918. 19 pp.

Technical Paper 208. How to improve the hot-air furnace, by C. W. Baker. 1918. 20 pp.

Handbook.

Efficiency in the use of oil fuel, a handbook for boiler-plant and locomotive engineers, by J. M. Wadsworth. 1918. 86 pp., 4 pls., 17 figs.

Note—Only a limited supply of these publications is available for free distribution, and applicants are asked to cooperate to insuring an equitable distribution by selecting publication that are of special interest. Requests for all papers can not be granted without satisfactory reason. Publications should be ordered by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

MacRae's Blue Book. America's Buying Guide. Vol. IX, 1918. MacRae's Blue Book Co., Chicago

This directory contains a list of thirty thousand American manufacturers of machinery, tools, and other supplies used by railroads and manufacturers, a list of manufacturers' representatives, a classified directory of makers of different products, an index of trade names, a collection of data useful to purchasing agents, tables of standard prices and a discount computer.

The A. B. C. of Aviation. By Captain Victor W. Page, Sig. R. C., A. S.

This is a most timely book, for it may well be believed that we are only at the beginning of practical aerial flight either for business or pleasure, and the time is not distant when a general knowledge of aviation will be imperative. No one could have been found better qualified to prepare such a book as this and the result is most satisfactory. All types of aircrafts are described, their principles of operation and the modes of manipulation and control. Detail drawings of the various types of airplanes are given, there is a full dictionary of aviation terms and the book is completely indexed.

Fusibility of Coal Ash and the Determination of the Softening Temperature. Prepared by Arno C. Fields, Albert E. Hall and Alexander L. Field and published by the Department of the Interior, Bureau of Mines.

The Bureau recognizing the value of information on this subject has made an investigation of laboratory methods, to determine the fusibility of coal ash, and the bearing of the results on clinker formation in fuel beds. This publication reviews the literature on the subject and gives in detail the effect of various oxidizing, reducing, and neutral atmospheres, such as are found in various parts of the fuel bed on the softening temperature of ash when molded in the form of Seger cones. As a result of this study a practical method of determing fusibility has been developed whereby the ash is caused to soften and form slag in which the iron exists in approximately the same state of oxidation as the iron in fuel-bed clinkers. The bulletin, in addition to the vast amount of information, contains many illustrations and tables in explanation on the subject. Copies of this publication may be secured by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C., with remittance of 20 cents.

Experimental Work at Old Portland Mill, Colorado Springs, Colo., by the U. S. Bureau of Mines under Dr. G. H. Clevenger:

1st. Development of the Caron Process for cyanidation of manganese silver ores. The ores are crushed and then given a reducing roast in the Caron furnace, a type of rotary kiln in which producer gas is used as the reducing agent and also as the fuel. Temperature about 600°C. The manganese oxides are reduced to the manganous state. This reduction decomposes the rebellious manganese—silver compounds — which may then be subsequently cyanided with a greatly increased extraction and reduced cyanide consumption.

2nd. The manufacture of carbon electrodes for use in the electric furnace from Colorado anthracite coal, retort carbon, or petroleum cake. The calcined material is properly sized and mixed with a binder of pitch or dehydrated coal tar. The hot mixture is tamped into a cylindrical mold. The solid core is removed and then placed into a baking oven. The volatile constituents are removed by a baking process. The result is a compact carbon electrode suitable for use in the electric furnace.

METHOD OF PROSPECTING PARADOX VALLEY

(Extract Rocky Mountain News)

In a contribution to Mine and Quarry, Wallace T. Roberts states that of the world's radium supply, 95 per cent is mined in Colorado. In Montrose county, in southwestern Colorado, extending through the Paradox valley over into Utah, are large deposits of carnotite, encircling the base of the La Sal mountains.

About six companies have holdings in the Colorado and Utah fields, but all of these are not operating. The largest is the standard Chemical company, with general offices at Pittsburg and head offices at Coke Ovens in Montrose county, about four miles from the town of Naturita, which in turn is about forty miles from Placerville, the nearest railroad point. The company's property extends over some 400 square miles of rather desolate country, characteristic of this part of the state. The Radium company of Colorado is another operating company.

The Standard Chemical company employs two methods of prospecting, both by means of drills. The first of these employs the diamond core drill. A series of holes is first planned, covering a given acreage, at intervals of twenty-five feet. If one of the holes indicates the presence of ore, a secondary series is then drilled around it, sometimes only a few feet apart, With the diamond drill holes, forty to fifty feet in depth, are commonly put in, this being as stated, the limit of occurrence of this ore below the surface.

The rig most used, of which a number have been in the district for several years past, is the Sullivan "Bravo" machine, operated by a belt from a gasoline engine. The drill, engine and pump for forcing water down the rods are mounted on heavy timbers with low wheels, so that moving from hole to hole is an easy matter. The great number of prospects and their shallowness makes this a handy arrangement. In this formation the rate of progress is perhaps thirty feet per shift. The cost is low because of this high speed and because the wear of diamonds is slight. At first borts were used in the pits, later black diamonds or carbons were employed, such as are used in all hard mineral formations with these drills. While the initial cost is more, the cost per foot of drilling is much less. Substitutes for the diamond drill have been tried, but the combination described above has proven most economical. The drills are operated by a crew of two men with a general foreman in charge of several machines.

Another method of prospecting, still more widely used, employs Sullivan air-tube rotator hammer-drills, weighing thirty-nine pounds each and operated by one man. These machines are used for the shallower holes, seldom exceeding thirty feet in depth. They employ hollow drill-steel in two-foot changes. A jet of live air, carried down the steel to the bits, acts to blow the cuttings to the surface in spite of such obstacles as clay seams, which are frequently encountered. The powerful rotation of the drill is a factor in enabling it to work successfully to such a depth. Light steel tripods are used to lift the longer lengths of steel. At intervals, or if trouble with dust arises, the steel is withdrawn and a blowpipe used to clean the hole.

These Sullivan hammer-drills are operated by gasoline engines driven air-compressors of the Sullivan WG-3 type.

The carnotite mines in a technical sense are seldom "mines" of much size or elaborateness, owing to the limited extent of the ore deposits.

When a body has been sufficiently mapped out and when production is desired from it, a slope is driven and the mining is accomplished with the air-tube rotators described above. Mining is done in the ore under the sandstone strata, on a specialized room and pillar system. The slope is so driven that the tracks are lower than the mining floor. The ore is carried from the face in wheelbarrows and dumped from these into the cars. These cars are of small capacity, and are hauled up the slope by a windlass or a small air-hoist. They are then dumped onto a canvas or platform where the ore is sorted by hand. Little of the carnotite ore runs above 5 per cent in grade. The value consists of uranium oxide, varying in grade from one-half to 7 per cent. Ore that must be milled is sent to a concentrator twelve miles from the offices at Coke Ovens, and from four to twenty-five miles from the camps. Shipping ore, including that above 2.5 per cent is sent to the company's works in Pennsylvania. All ore is placed in sacks, weighing 100 pounds each, as it is sorted, owing to its great value. John I. Mullen is in charge of the Standard Chemical company's property and has overcome many difficulties.

PERSONALS

'98

Orville Harrington is recovering from an operation performed at St. Luke's hospital, Denver, in which one foot was amputated.

'01

A. K. McDaniel has purchased a new home at 700 Franklin street, Denver. He is now assistant manager for the Western Chemical Co., manager of the Greenback Mining Co., and doing general consulting work.

'02

W. Ray Cox, Mineral Examiner of the U. S. General Land Office at Portland, Oregon, is now located at the Portland Field Division headquarters, which have just been established at 616 new Post Office Building after removal from 310 Custom House.

'03

G. Montague Butler is now director of the Arizona Bureau of Mines. He is also Dean of the College of Mines and Engineering of the University of Arizona. Since going from the Oregon Agricultural College to the University of Arizona, "Monte" has succeeded in getting a wonderful new engineering building.

'04

F. B. Hyder is now with the U. S. Bureau of Mines, 2114 New Interior Building, Washington, D C,

'06

George A. Parks was in Seattle, Washington, the latter part of January en route to Juneau and thence to the interior of Alaska. He has resumed his duties as a Mineral Examiner of the U. S. General Land Office after having been released from the army. While in the military service, he was an officer of engineers, first at Camp Lee, Virginia, and later at Camp Sheridan, Ala.

'09

T. D. Benjovsky was in Denver recently enroute to Cuba, where he is going to examine some phosphate lands.

'10

Sam Soupcoff recently resigned his position as resident engineer for the Salt Lake department of the A. S. & R. company to engage in private consulting work in Salt Lake City. He has gone to Mexico on an extended professional trip.

'11

Arthur N. Zwetow and W. J. Mayer expect to receive their discharge from the aviation corps in the near future, and will return to their consulting engineering practice with offices in Salt Lake City.

'12

Paul Hillsdale and associates are developing some copper properties at Wenden, Arizona.

James E. Dick has returned to his office, 1023 First National Bank Building, Denver, after a short visit to his home in Akron, Ohio.

'13

D. R. Dove has received his discharge from the army and at present is doing experimental work at the Colorado School of Mines Experimental plant.

Harry M. Cronin is now chemist for the C. S. M. experimental plant.

F. A. Downes writes from "over there": "Have been in France since August 18. Have not been on the front lines but have been within easy shelling distance and the Boche didn't let us forget it, either. Also in the air 'Fritz' kept us uneasy. If there was a black cross on a machine overhead, all work ceased for the time being."

Mr. and Mrs. Walter Heinricks of Superior, Ariz., announce the arrival of a fine baby boy at their home last Thursday. Mrs. Heinricks was formerly Miss Mary Smith of Golden. Mr. Heinricks is well-known here and is a gradute of the School of Mines.

Seymour P. Warren is in Denver with W. A. Butehardt.

'14

LeMans, France,
13 Jan. 1919.

Not knowing whether you know my address, (since I've received no copy of the Magazine since July) I'll send you a few lines.

I am overseas with the 306th Engrs., 81st Div., but was transferred later to the 6th Engrs., reporting to them on Sept. 25th, the day before the great American offensive commenced.

On Oct. 20th, I was wounded in the right forearm by a machine gun bullet (while attacking with Inf.,) was sent back to Base Hospital 43 at Blois. The Unit there was from Georgia and the doctors and nurses certainly treated us fine.

On Dec. 6th, I was pronounced "A" class again and sent to the Classification Camp at Le Mans. Am delayed near there at present with other officers and men (all hospital evacuates) from the 3rd Div., but expect to be sent up to rejoin them (the 3rd Div,) soon. They are billeted near Coblentz.

I'm in hopes that all is going well at the school this term, I am

Most sincerely yours,

William L. Beck, (C. S. M. Class 1914)
2nd Lieut. Engrs., U. S. Army; 6th Engrs., 3rd Division; (Now in army of Occupation); Address A. P. O. 740., Amer. E. F., France.

'15

First Lieut. John J. Cadot, of the non-flying section of the aviation corp left France the middle of January. He is expected back in Salt Lake City by his firm—The Hardinge Conical Ball Mill Co.

'17

Rex P. Oliveras has received his discharge from the Feld Artillery and is now employed in the engineering department of the Primos Exploration Co, Empire, Colo. Address in care of the company.

Capt. Sidney Newhirter visited the school during January. He recently returned to his home after having seen several months service in France. Capt. Newhirter expects to go to Morenci, Arizona, where he has a position.

Lt. Frank E, Briber is with the Army of Occupation. He was at the time of writing at Vance, Belgium, enroute for Germany.

'18

N. R. Copeland is now employed in the experimental department of the Primos Exploration Co., Empire, Colo. Address in care of the company.

'19

John Bynon Ex. '19, is back in Denver, having been discharged from the Naval Aviation branch of the service.

George Roll of the class of '18 has received his discharge from the aviation corps and has returned to his classes in school.

Dr, R. B. Moore, Director of the Golden station of the U. S. Bureau of Mines, returned to Golden for a short visit recently. Dr. Moore has been engaged in the production of Helium from the gases of some of the oil fields in Texas.

Mr. Jack Bonardi of the Golden station of the U. S. Bureau of Mines left the first of February for the Seattle station. He will be gone several months in order to do some special flotation work in co-operation with Mr. Will H. Coghill.

Appreciates the Magazine

Hillsdale, Multnomah Co., Ore.,
January 31, 1919.

Editor Colorado School of Mines Magazine,
Lock Box B., Golden, Colo.

Dear Sir:

I am very glad to receive again a copy of the School of Mines Magazine. Although my work keeps me away from home much of the time, I have noticed the Magazine has not been coming for some time and I have wondered as to the exact cause. The latest number I am able to find is that of August, 1918. If any later numbers between that date and January, 1919 number just received are available I would be glad to have you send them, Enclosed herewith find check on Ault, Colo., for $1.50 in payment of my subscription for the calendar year 1919. I will be glad to receive the magazine regularly hereafter and am glad to help along the cause of the magazine to that extent at any rate.

W. RAY COX, '02.

OBITUARY

On January 18th, at the Children's Hospital in Denver, John M. Pendery, of the class of 1900, passed away at the age of 41. Mr. Pendery was a son of Judge and Mrs. H. R. Pendery of Leadville, Colorado. Since graduation Mr. Pendery spent most of his mining career in Leadville where he was geologist and engineer for the Yak mine up until 1917 when his health failed him. One of the vertebra of the spinal column had pressed against the locomotive nerves going to the legs and almost completely paralyzed them. Efforts were made to remove this pressure by casts so that he could regain his strength and activity. The last cast caused a congestion of the blood which developed into blood-poisoning, which caused his death.

In spite of the duration of his affliction, Mr. Pendery never lost hope of getting back into the active pursuit of the profession in which he started out so splendidly toward making a name for himself in unraveling the complex geological problems of the Leadville District. His cheerfuness, optimism and unselfishness in his affliction were so marked that any one who came in contact with him marveled at these virtues and were inspired by them.

Mr. Pendery was active in the Masonic and Elk Fraternal orders. He was buried in Leadville with Masonic honors. He is survived by his father, mother and sister,

C. E. W.

James S. Thompson, a graduate of the Colorado School of Mines in the class of 1899, died very suddenly of heart failure at Sunnyside, Utah, January 15th. Thompson was a very popular student of the school while here and an active participant in all athletics during his days. Thompson was 44 years of age at the time of his death. For a number of years past he has been general superintendent for the Utah Fuel Co., at Castle Gate, Utah. He leaves a wife and young son to mourn his death.

Edward M. Rabb, a widely known mining engineer and a graduate of the Colorado School of Mines in the class of 1905, died in the officers' hospital in Tonopah, Nev., January 20th, of Spanish influenza which he contracted shortly after arriving there on January 2nd. Rabb was with the Phelps-Dodge Mining company in Mexico for a long time after leaving the School of Mines. For the last two years he was manager of the Ajax mine at Victor, Colo. He left Denver on New Years day to look after the interests of the Ajax company in Tonopah, contracting influenza shortly after his arrival there. The body was shipped to Denver.

ATHLETICS

Miners' Hoop Team Defeats Ministers

The School of Mines basketball five opened its season on January 26th by defeating the Denver university team in a game that started quietly, but developed into a fast and furious contest. For the first two minutes of play the men were actually ladylike in their attitude toward each other. And then the game was speeded, and was so hotly contested that seventeen fouls were registered. In the first half Denver university did not make a field goal, the count of four points being from fouls. Robb of the university was found guilty of three personal fouls in this half. At the close of the period the score was: Mines 13, Denver university 4.

The university boys made a spurt at the opening of the second half, but could not catch up with the Miners. Within two minutes of the close of play, with the score 21 to 17 for the Miners, time was called to give the players a needed rest. Upon the resumption of play each team made two field goals, that placed the score: Mines 25, Denver 21. A feature was a field goal made from the center of the floor by King of the university,

The lineup and score:

Miners	Position	D. U.
Miller (9)	F	Cutler (0)
Bryan (4)	F	Robb (6)
A. Bunte (6)	C	McLaugh'n (11)
E. Bunte (2)	G	King (4)
Dunn (2)	G	Stone (0)
Pittser (2)	Sub	Loeffler (0)

Officials—Referee: Scott of the Aggies at Fort Collins. Umpire: Ellison.

Colorado College 25
Mines 23

At Colorado Springs on Saturday February 1st, the Tigers defeated the Miners by the score of 25 to 23 in one of the fastest games that has been played on Cassitt's floor in years,

The Miners took the lead in the first five minutes of the game and retained it by a small margin until the last ten minutes of play when C. C. gradually closed the gap and in the last few minutes of play tied the score—23 to 23.

In the extra five minutes period

which was necessary to decide the game. L. McTavish threw a basket making the score 25 to 23.

The Mines rooting section was very small but the old fighting spirit prevailed nevertheless throughout the game,

The line-up:

Mines		C. C.
Miller	RF	L. McTavish
Bryan	LF	Simpson
A. Bunte	C	Honnen
E. Bunte	RG	Whitehead
Dunn	LG	E. McTavish

CLASS NOTES

SENIOR NOTES

The class of 1919 has been strengthened by the return of W. O. Charles and Geo. Roll, who were recently discharged from the service. Charles was an aviation cadet and Roll a 2nd Lieutenant in the flying corps.

Capt. "Stumpy" Miller of the hoop quintette is leading the Mines team to another championship banner and we still have hopes of seeing him shoot a basket standing on his head —to date he has gotten one from every other possible position.

Parker and Conley were pledged Tau Beta Pi last semester and a proof of their engineering (?) ability has appeared on the campus for several weeks.

The telephone and street car service between Golden and Denver have been a considerable source of worry to Coulter recently—the cars don't run fast enough and they don't let you talk long enough on the telephone. "She's a damn fine girl."

Mulford has received his second wrinkling—Capt, Stumpy officiated at the ceremony.

Romine and Mechin have lately become the social lions of the class and may be expected to appear in frock coats any morning.

JUNIOR NOTES

On account of the departure from these regions of Don Bailey, our friend and class reporter, it falls to the lot of some one else to write of the lustrous class of 1920. Bailey left school at the close of the last semester and is now working for the Golden Cycle company. We expect and hope to have him again in our midst next year.

Our class is increasing daily, but we are advised by Prexy that it has not yet reached its maximum. Many of our classes resemble an army training camp. These uniforms make many of us think about things we would like to forget.

Jack Fessenden is again in school. He left school last year to join the marines. E. B. Hardy has also returned after a years' absence on account of sickness,

"Red" Brown was selected from the Junior class for membership in Tau Beta Pi. He was a busy man last week when he helped survey and make the big key which is now seen on the campus.

Between Assaying and Mine Mapping the Juniors have been so busy lately that the picture show man says he will drop them from his class unless they attend more regularly. We were so busy while in the S. A. T, C. and so glad to get out when we were discharged that these courses were more or less slighted. Everyone is now looking forward to the day when things will be as they used to be.

SOPHOMORE NOTES

To quote Prof. Ziegler, our sophomore class is gradually recovering from the effects of the influenza, the S. A. T. C, and a few other less important epidemics. We have reorganized and are already wondering how to repay our Frosh debts.

At the last class meeting Hale Strock was elected class president; Fred Brinker, vice-president; Jack Suflue, traesurer and Ronald Deford (the native son) secretary, (California papers please copy). The class feels that under the management of these men the remainder of the year will be very successful,

Among those of our class who left school this year are Bill Heydrick, Henry Fidel, Al. Jenni and Charles Bettors. Latest reports indicate that Bill is taking a fine arts course at Boulder while Fidel is doing a little research work in the sugar beet industry. Jenni condescended to accept a position as general manager of one of the steel plants in Pueblo. It is understood that Bettors is giving the girls of Colorado Springs a treat.

Frenzell has been annoyed a great deal lately by the opposite sex. They won't let him alone, He is already preparing for the great spring offensive.

When the order came out from the office that all home work must be handed in on thesis paper some one suggested that Prexy probably invested in a paper mill recently. With thesis paper at a half-cent a sheet and problems averaging seventeen feet in length most of us will not have money left to pay our board bill.

After taking the Mineral Land final and spending four hours a night on calculus we feel that Engineering should be taught only in states where the days are thirty-six hours long.

Our class, as well as the upper classes, feel that it is a duty of the freshmen to give a ball this year and would be very glad to hear a little agitation on the subject.

FRESHMAN NOTES

After a spirited meeting with much close rivalry, the Freshman class elected its officers. They are as follows: Albert E. Merry, president; Lewis J. Bryan, Vice-president; Merle Jackson, Secretary; Louis C. Rhodes, Treasurer and Neil A, Rice, Class Editor. The class then participated in a little informal installation in which the newly elected officers were the center of attraction.

A good many members of the class left school at the end of the first semester. To a certain extent these members have been replaced by new members entering at the beginning of the second semester. Among those who left were Fahey, Epeneter, Derryberry and Wright, all of whom were members of this year's football team. Notwithstanding this loss, we have plenty of good material left for cur other teams. In basket ball, Bryan, Rhodes, Bunte, Jackson and Davis are all stars and there are others just as good.

After such a long Christmas vacation everybody feels like getting down to real work. From all appearences our scholastic record is going to be on a par with our athletic record.

S. A. T. C.

Simultaneous with over 550 other Class "A" colleges and universities, on October 1, 1918, the students of the Colorado School of Mines were formally organized into a unit of the S. A. T. C. Owing to the remote distances at which many of the enrolled students lived, the organization of the unit was not completed until November 2.

The method of bringing these students to the colors was by individual induction through the Jefferson County Local Board. In most cases the order for induction originated at the headquarters of the unit.

A splendid record was made by the college in the high percentage of men accepted as physically fit for general military service. The induction was completed on November 2. The student soldiers were given the usual immunization against infectious diseases by prophylaxis and vaccination.

The unit consisted of 162 men and was organized into one company of four patoons and twenty squads.

The daily schedule was as follows:

First Call—6:00 a. m.
Reveille—6:15 a. m.
Breakfast—6:30 a. m.
Military Work—7:00 to 8.00 a. m.
Academic Work—8:00 a. m. to 12:30 p. m.
Military Work—1:30 to 2:30 p. m.
Academic Work—2:30 to 5:10 p. m.
Athletics—5:10 to 7:30 p. m.
Supervised Study—7:30 to 9:30 p. m.
Quarters—9:45 p. m.
Taps—10:00 p. m.

The men were housed in the Fraternity and other available houses, keeping each platoon separate. The cafeteria plan of serving, the meals was adopted; a few men were detailed each day to assist in serving the cooked food. Kitchen duty, that bugbear of the enlisted man, was thus largely obviated. There was no Guard Mount and a minimum of eight hours sleep was demanded from each man.

During the hours devoted to military training, the men were given physical drills, as used so successfully by Major Keeler for 33 years at West Point. Close order formation, bayonet and grenade drill, gunnery, gas defense, practice in the administration of company bookkeeping, and lectures from the different officers on military work, sexual diseases, personal and camp hygiene and sanitation, and the psychological laws governing the individual and the crowd, both in peace and in war, constituted the rest of the studies. The plan used in lectures with most success was to give each lecture to a platoon.

The hospital work was first carried out by Dr. Packard of the C. S. M. faculty, and later by Lieut.-Col. Malejan, formerly on the faculty of the University of Michigan.

Aside from what the men may have profited through the learning of the meaning of the word discipline, a little credit must be given the courses in personal and camp hygiene, in the prevention of the "flu" epidemic which in many cases caused long and serious cuts in the school year, but which was limited to a two weeks' attack at the C. S. M.

Camp hygiene is just as applicable to the mining camp as to the army camp and presents a much larger peace time. field.

The importance of psychology is as yet but little appreciated by the average business man, but the importance of which can best be realized by a few examples. Of the men who remained in Officers' Training Camp after the preliminary weeding-outs, almost 50 per cent were rejected or transferred on the results of their psychological examinations. It was the knowledge and application of psychological principles that has made an unthought of record in the Allied armies as to the small number of soldiers executed for desertion, cowardice, and similar crimes.

Army officers with this experience are now being employed by employers in an effort to increase efficiency and cut down the labor turnover.

Since the S. A. T. C. was demobilized, the C. S. M. has made application for and received the necessary permission to establish a unit of the R. O. B. C. Military instruction under Lieut. McKee, U. S. A. This will consist of physical drill and lectures similar to those given the S. A. T. C. but more comprehensive.

An Experience in Cuba

Denver, Colo., Jan. 24, 1919.

My dear Mathews:

It certainly is a pleasure to receive a Colorado School of Mines Magazine again, especially pleasant when some one else had the worry and work of getting it out. I certainly wish you the best of success personally and hope that the Magazine safely started again on an era of prosperity.

As you may have heard, I am back in Denver again, for a while at least, Last June I had trouble with my crippled foot and went to Covadonga Hospital in Havana and had the rest of the toes removed. The big toe was infected in the operation and the foot refused to heal entirely, and while I was back on the job early in July, on crutches, and managed to get around pretty well, I even managed to go out to sea three or four miles in small gasoline launches, and climb up the rope ladders to board the big ore ships.

I finished loading one boat in the tail end of a cyclone and couldn't get to shore with the stevedores until twelve hours later as the tugs could not get out to the boat for the heavy wind and sea. We made very good records loading boats all the time I was down at Santa Lucia. Invariably we loaded them in less time than they were unloaded in the U. S. (at Chrome, N. J.) even when they used machinery.

We loaded one 2200 ton boat in two days, which is some record. The ore is shoveled from flat deck barges into 40-cubic ft. buckets, hoisted aboard and dumped into the hatches. At the boats we worked two gangs of stevedores—thirty men in all—loading into two hatches at the same time. Out of each gang only eight men are shoveling at a time, the other seven being engaged in hooking and unhooking the buckets, snubbing them so they will swing clear of the side of the ship, swinging the booms around and dumping the buckets into the hatches. So I think 1100 tons a day is some record for shoveling, thirty men in all, with only sixteen shoveling at one time.

The stevedores are nearly all negroes and picked men. The incentive was overtime pay and bonuses which brought each stevedore's pay to about sixteen dollars for the two days. Not excessive pay for the long hours in the states, but pretty good for Cuba where the peons receive from one dollar to a dollar sixty for ten hours work. As a rule the Cubans do not like to work very hard but you see they can when they have the proper incentive.

I got discouraged about my foot healing or rather not healing, and started for Denver about the first of December to get good surgical advice and attention. Then, of course, the foot decided to heal up. We were delayed ten days in Havana because of a general strike and the canceling of sailing because of the strike,

For some weeks there had been a strike on one of the rairoads in eastern Cuba, caused primarily because a new superintendent had put a stop to much of the grafting and stealing of freight. Then a secret committee called a sympathetic strike in the province of Havana of all union labor, and closed down all the street cars, jitneys, and many of the electric light plants. They called out all clerks in stores, all cooks and waiters, all stevedores and all tram men. Even the newspapers were stopped. The same day the general strike was called the original strike was settled, but the general strike continued for several days until the government began to arrest all union men who wouldn't work, and compel them to work as stevedores unloading boats. When the government discovered some or all of the members of the secret committee and made them work on the docks, the strike was called off in a hurry. Well, we finally got started for New Orleans and Denver on a United Fruit boat from Colon, and arrived in Denver late Christmas eve. There on Christmas day I succeeded in burning my bum foot badly and did what I should have done years ago—had it amputated just below the knee. Now I can get a "good" foot. The leg is doing as well as can be expected and I hope to be out rustling a job very soon, and without crutches.

Yours sincerely,
ORVILLE HARRINGTON,
1485 S. University St.,
Denver, Colo.

Scholarships in the Colorado School of Mines.

The following principles govern the award and the holding of scholarships:

1. Scholarships are awarded to High School or Academy graduates of the current year who show market proficiency in their studies and are recommended by the proper school official.

2. Application with recommendations must be on file with the Registrar on or before July 1, of the year of graduation.

3. A candidate must satisfy all requirements for admittnace without conditions.

4. All scholarships are awarded for a period of four years and exempt the holder from all tuition or laboratory fees.

5. A scholarship will be terminated if the holder does not maintain a satisfactory standing or does not comply with the requirements of the faculty or the trustees.

6. If the holder of a scholarship leaves school permanently his scholarship may not be assigned or transferred.

7. The holder of a scholarship may, with the consent of the president secured in advance, absent himself from the school for a period of not more than one year and retain his scholarship.

8. Army and Navy scholarships are not available after September 3, 1919.

9. The monetary value of scholarships to residents of Colorado is approximately $50.00 annually: to non-residents approximately $200.00 annually.

Beaten to It

"Germany, confessing her wickedness and protesting her repentance, reminds me of a rascally fortune hunter," said the director of military aeronautics, General Kenly.

"This fortune hunter was describing his pursuit of a Pittsburgh heiress:

"'In proposing,' said his listener, 'you ought to have told her, George, that you were unworthy of her. That bait seldom fails.'

"The fortune hunter gave a gloomy laugh.

"'Yes I was going to tell her that,' he said, 'but she told it to me first."

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COLORADO SCHOOL OF MINES MAGAZINE

THE COLORADO SCHOOL OF MINES ALUMNI ASSOCIATION, PUBLISHERS, GOLDEN, COLO.

ARTICLES

FINANCE
THE PERIOD OF READJUSTMENT

By Victor C. Alderson,
President Colorado School of Mines

THE GREAT EUROPEAN WAR

The Conflict of Ideals

The recent war has proved to be the most frightful and the most costly of any war in the world's history. The most valuable stakes have been involved—the national life and liberties of the greatest of nations—the United States, Great Britain, France, Italy, Germany and Russia. The conflict itself, when viewed in the light of history, is seen to be like the ancient wars, the Thirty Years war, the Napoleonic wars, the internal struggles of England, our own Civil war, and the Spanish war, all struggles for the supremacy of one of two ideals of life and government—the government of the few or of the many; the Teutonic or the Anglo-Saxon ideal of life. Whether we call it a war against personal ambitions, autocracy, Prussianism, or militarism—the contest resulted from a long continued effort to establish one ideal to the exclusion of the other.

This decade is the most unusual, the most chaotic, the most momentous of the world's history. Events of world-wide importance succeed each other with hardly an interruption. Great battles, long casualty lists, the fall of empires, the tottering of thrones, form our breakfast-table themes of conversation. It is difficult for us to accustom ourselves to this new international panorama. Although the war is over, our troubles are not. The torch of anarchy is waving over Russia and Germany. Governmental struggles are rife in Poland, the Balkans, Ukrainia, and the smaller states that have been born of the overthrow of the central European monarchies. This colossal upheaval is causing political, economic and labor problems of the highest importance to us, and their solution presents the greatest problems of the decade.

The Treaty of Versailles

The Teutonic ideal has been badly broken; Germany has been defeated; the Anglo-Saxon ideal is supreme; the armistice has been signed; the Peace Conference is about to be held; Germany will be told what she must do to make amends, as far as lies in her power, for the crimes she has committed. This gathering of representatives of the great nations has before it a colossal task, and its findings will have far reaching effects—political, financial, social, and industrial—upon the entire civilized world. It is well, therefore, to watch the larger matters involved so as to get a clear idea of the trend of events.

The League of Nations. In what way will this differ from the old "Balance of Power," from former alliances, defensive and offensive, between nations and from the "Concert of Europe"? What new principles are involved? Will France, for example, trust a League of Nations to protect her in the future from the aggressions of Germany, or will she insist upon a strong line of fortifications on her eastern border planned, equipped, and controlled by herself alone? The same questions may be asked in reference to Italy and her new Austrian border; of Roumania, Bulgaria, the Slovak states, and other new, independent states that will surely be born at Versailles.

The Freedom of the Seas. The meaning of this phrase seems clear to one who does not examine closely into the minutiæ of the matter, but the burning question to keep in mind is this: since Great Britian has long maintained a navy equal in strength to that of any other two nations; since her geographical position and her consequent dependence upon foreign nations for her food, demand that ocean transportation shall always be kept open to her; and since she has always maintained the freedom of the seas for herself and all other nations, will she be willing to entrust the security of her national life to a League of Nation?

National Sovereignty. Undoubtedly a League of Nations will require that each nation shall yield some degree of sovereignty to an international army or navy, a supreme world court, or other evidence of supreme authority. In a League of Nations not all could or should have the same influence. Will a smaller nation like Switzerland, for example, that has maintained its neutrality and independence for more than six centuries, place its security and independence in the hands of a League, no matter how altruistic and idealistic its notions may be? On the other hand, the new and smaller, freshly born, states of Europe will ask to be recognized as free and independent, and will look upon the Congress at Versailles as their deliverer from the yoke of a conqueror.

Terms of Peace. The detailed terms

subjected manganese-silver ores from Sumatra to the action of various reducing gases, under a variety of conditions.

About this time The Buffalo Hunter Mining, Milling and Development Co., operating near Silver Cliff, Colorado, was facing the manganese-silver problem in connection with the exploitation of certain deposits of silver-bearing rhyolite. Both the Sumatra ore and the Silver Cliff ore were then made the basis of various tests with the Caron process, with very promising results. These two ores are interesting because of their similarity and their difference. Both ores contain silver-manganese combinations, and refuse to yield their silver under the usual treatments with cyanide solutions; but the two ores are entirely different in physical structure and in mineral value. The Sumatra ore is spongy, cellular, and porous, and upon crushing has a tendency to dust and yield considerable fine material. Its mineral value is high in both silver and manganese, assays indicating frequently over 200 ounces silver a ton. The Silver Cliff ore is a hard, somewhat shattered rhyolite, carrying small stringers of manganese dioxide which appears to be replacing silica. On crushing, the ore breaks into angular, glassy particles, and has no tendency to dust or yield an abundance of fine material. The assay value is low, indicating from 3 to 10 ounces of silver, and 5 to 10 per cent manganese.

Following the laboratory experiments, tests were made on a larger scale, and a small Wedge-type furnace, supplied with producer gas, was used. Later, in order to secure greater freedom and convenience in developing special apparatus, the testing was done at Colorado Springs. At this time H. G. Clevenger, metallurgist in the U. S. Bureau of Mines, cooperated with Mr. Caron in the design and operation of an experimental plant to test manganese-silver ores on a working scale. This equipment was located in one of the Portland mill buildings southwest of Colorado Springs. Two furnaces, or kilns, were erected for the purpose of giving the ore a reducing roast. One of these kilns was externally heated, and the other was internally heated. The externally heated furnace was fired with bituminous coal. The internally heated furnace was designed to burn producer gas in the heating zone. The producer gas was supplied at first by a Reché producer which distilled scrub oak, and was fired with bituminous coal. Later, the producer gas was supplied by a small coke-fired, pressure type, up-draft producer. The two kilns were of the tube-mill type with tires, supported and driven by rollers and the necessary gearing. They were inclined at an angle calculated to insure proper travel of the ore at suitable speed of rotation, and within a desirable range of capacities. The cyanide equipment included a small tube mill charged with flint pebbles, a Dorr agitator, a zinc dust agitator, centrifugal pump, and filter press. The apparatus was driven by electric motors.

Description of Kilns Used.

The externally heated kiln, used in the tests made on August 28, 1918, was made of a 10-inch iron pipe, 32 feet long, fitted with tires, and supported by three sets of 2½-inch by 16-inch rollers and two sets of 3-inch by 4-inch rollers. The pipe was supported on a slope of ¾-inch per foot. The upper 17½-feet of the pipe was enclosed in a fire brick furnace, with a clearance of about six inches between pipe and furnace walls; this is the heating zone. The remaining 14½ feet of pipe was not enclosed, and forms a cooling zone. About six feet of the cooling zone was wrapped with cocoa matting upon which water may be permitted to drip, for the purpose of wetting the matting and assisting in cooling the tube as a result of evaporation. However, as the cooling zone was found to be longer than necessary for effective cooling, this matting was not required.

The rollers which carry the tube were mounted on two parallel I-beams supported on concrete piers. The furnace was provided with two fire boxes, fitted with steam jets for draft regulation, and designed to burn bituminous coal. The fire boxes were about 24 by 24 by 36 inches inside, and 40 inches wide by 52 inches long by 50 inches high, outside measurement. Each fire box was provided with five steam jets, arranged four in front and one on the side.

The upper end of the tube projected out of the furnace and received a three-inch iron feed pipe from a supply hopper provided with an automatic feeder. This automatic feeder may be regulated so as to feed any desired weight of ore per hour. The upper end of the furnace connected with a flue which leads to a stack.

The lower end of the tube projected through a suitable packing gland into a receiving chamber fitted with a hopper bottom and ore outlet pipe, gas inlet pipe, and a convenient split-pipe sampling device. The ore outlet pipe delivered the reduced ore to five-gallon cans used as containers and fitted with air-tight lids. The reduced product was stored in these cans until a suitable quantity was accumulated for a cyanide test.

Producer Gas Used.

The gas used for reduction purposes was generated in a Reché producer, from scrub oak obtained near the plant. The producer was fired with bituminous coal. The gas from the producer was stored in a receiver of suitable capacity, and delivered to the tube through pipes fitted with valves for proper control.

Experiments with Externally Heated Kiln.

In making a test with the externally heated kiln on August 28, 1918, the fires were started at 6:45 a. m., and the first ore was fed into the kiln at 8:15 a. m. The initial feed was at the rate of 50 pounds per hour. The material was a concentrate including all sizes from 16 to 40 mesh. The tube was rotated at a speed of 0.62 of a revolution per minute. Under these conditions the material passed from one end of the mill to the other in two and one-half hours. The temperature of the furnace varied from 530 degrees to 600 degrees centigrade, or from about 986 degrees to 1112 degrees Fahrenheit, as indicated by pyrometer measurement. Later experiments indicated that a temperature of about 650 degrees centigrade, or about 1200 degrees Fahrenheit, gave the most satisfactory results.

The stream of ore passing through the tube mill was about one-half to three-quarters of an inch deep and four to five inches wide. In previous tests it was found that the ore stream had a tendency to coast down the smooth inside surface of the tube, with deficient mixing and consequent incomplete reduction. This condition was remedied by placing baffles inside the heating zone of the tube, consisting of four longitudinally-disposed rods of ½ by ½-inch square iron, bolted to the inside of the tube. These baffles raised the ore and allowed it to drop in a thin sheet through the reducing gases, resulting in a very satisfactory reduction.

The producer gas was admitted at the lower end of the tube, and flowed upward through the kiln in a direction opposite to that of the ore. Proper gas regulation required sufficient volume to accomplish thorough reduction of the ore, and without any unnecessary loss of unused gas at the upper end of the kiln.

While the kiln was in operation, from time to time samples of reduced material was taken from the lower end of the tube by means of the sampling device, and tested for higher oxides. The quantity of ore fed into the tube was then increased until higher oxides began to appear at the lower end, indicating the limit of capacity under the existing conditions. During the test described, the feed was increased from 50 pounds per hour to 90 pounds per hour, and then reduced to about 75 pounds per hour. With a feed of 90 pounds per hour the tests indicated higher oxides to an extent which demanded a close regulation of the feed.

Chemical Test for Determining Higher Oxides.

The test for higher oxides is made as follows: A small quantity of ore is treated with hydrochloric acid in a flask fitted with a stopper and a bent glass tube. If higher oxides are present chlorine will be generated according to the equation: $MnO_2 + 4HCl = MnCl_2 + Cl_2 + 2H_2O$. If the gas escaping through the glass tube be allowed to bubble through a solution of potassium iodide, a greenish color will develop in the solution if the gas contains chlorine, the reaction being: $KI + Cl = KCl + I$. Tests indicating higher oxides in small quantity would not indicate necessarily a serious condition, for it was estimated from experiments that the quantity of higher oxides resulting from a feed of 90 pounds per hour as compared to a feed of 75 pounds per hour would probably reduce the extraction of silver in subsequent treatment by cyanidation by about three per cent. An analysis of the reduced ore from the lower end of the tube, where small quantities of higher oxides were indicated by the test above described. showed that about 97 per cent of the material was in the form of MnO, and the remaining three per cent was in the form of MnO_2, showing that the test was quite sensitive, and a reliable guide in operating.

Prevention of Reoxidation.

As the oxidized ore came from the lower end of the tube it was allowed to fall into a tin container. The reduced material felt cool to the hand, but if allowed to stand exposed to the air for any length of time it would become warm, indicating a certain amount of reoxidation. As a precaution against the reoxidation, a small quantity of the reducing gas was fed into the container while it was being filled with the reduced ore, and when it was full a tight fitting lid was adjusted to exclude the air until such time as the material could be subjected to cyanidation.

Description of Cyanide Equipment for Tests.

The cyanide equipment and its operation are described as follows: The tube mill, or milling drum, is 34 inches in diameter and 40½ inches long, mounted on trunions, and operated by means of a belt drive and gearing. The drum is lined with corrugated cast iron liners, with the corrugations running lengthwise of the mill. The mill contains 700 pounds of two-inch flint pebbles. These pebbles were used because an abundant supply happended to be on hand at the plant.

The reduced ore collected in the containers at the kiln was accumulated until a charge of 150 pounds was available for cyanide treatment. This 150 pounds of reduced ore, together with an equal weight of water, was charged into the milling drum. From 4 to 5 ounces of sodium cyanide was added. The drum was rotated at about 40 revolutions per minute for a period of two hours.

Compressed air was forced into the mill through one trunnion, and allowed to escape through the other trunnion. Without the admission of air to the mill, the extraction of the silver during a two-hour run was 1.2 per cent. With the use of air the extraction in the drum was about 80 per cent.

It was found unnecessary to add lime in making the tests because the protective alkalinity was equivalent to about three pounds per ton. However, experiments were made with lime in order to investigate its effect, and in some cases a small addition was considered beneficial.

Following the two-hour period of milling in the revolving drum, the charge was dropped through a side discharge door into a launder which delivered to a Dorr agitator. This agitator is four feet in diameter by five feet high. The vertical column is fitted with additional arms to increase the agitation, and to provide for effective agitation with charges of different heights in the tank. The agitator operates at 24 revolutions per minute. The charge passed from the drum to the agitator was diluted to three to one by the addition of twice the quantity of water used in the drum. Agitation was continued for periods up to 125 hours, and extraction tests were made at suitable intervals for the purpose of determining the most effective period of agitation from a commercial standpoint.

Following the period of agitation, the charge was allowed to settle, and the clear solution was decanted to a zinc dust agitator. Following a brief agitation with zinc dust, the solution was pumped by means of a centrifugal pump into a filter press with 20 18-inch plates. The Dorr agitator has a capacity sufficient to take care of four charges from the milling drum. Therefore, it was the practice in making the tests to agitate four such charges at the same time. During the preliminary tests all extraction figures were based on the head and tail samples, and not on bullion results, on account of the possibility of loss of solution during testing.

Experiments with Internally Heated Kiln.

In order to determine the possibility of a more positive heat regulation inside the kiln, and at the same time to reduce the fuel consumption, an internally heated kiln was designed. This kiln was a cylinder 32 feet long with an inside diameter of ten inches. The upper 17½ feet was enclosed in a larger pipe so as to provide for a three-inch refractory lining. The cylinder on an I-beam frame which rested on concrete piers. The cylinder was revolved by means of a belt drive which actuated a worm and wheel, and spur gearing. The inclination of the kiln was ¾ of an inch in one foot, as in the externally heated kiln.

The upper end of the kiln projected into a flue which connected with a stack, and provision was made for automatic ore feed similar to that of the other kiln. The lower end of the tube projected through a suitable packing gland into a receiving chamber fitted with a gas inlet pipe and ore outlet hopper, which rode on the end of the tube. An air inlet pipe passed through the terminal chamber up the center of the cooling zone of the kiln, into the lower end of the heating zone, and thence through the side of the kiln to the outside thereof, whence it was mounted on the outside of the heating zone and parallel thereto, forming a bustle pipe from which four air inlet pipes provided with valves passed into the furnace. This arrangement permitted admission of air to the heating zone, under regulation, so that the burning of the producer gas in this section of the furnace can be controlled as desired. This form of kiln was designed to accomplish the proper reduction of the ore by making the producer gas serve the double purpose of supplying the reducing agent, and acting as fuel to produce the necessary heat. Tests with this internally heated furnace showed that it would require no external heating, and that the cost of coal for such purpose would be saved, and that this saving would amount to more than the cost of whatever additional producer gas might be required.

In the test made with the internally heated kiln on November 13, 1918, the apparatus was working perfectly with an initial feed of 60 pounds of concentrate per hour, which quantity was later increased to 90 pounds per hour. The gas was supplied by a small coke-fired, updraft, pressure-type producer, made from scrap materials found at the plant. The volume of producer gas used was 45 cubic feet per minute, under 1.27 inches of water pressure. The barometric pressure was 605 mm of mercury. The average analyses of the gas entering and leaving the kiln were as follows:

Constituent.	Producer Gas.	Waste Gases (by volume)
CO_2	2.0	12.3
CO	27.0	9.7
O_2	1.3	2.0
H_2	8.5	3.0
N_2	61.2	73.0

The temperature of the producer gas at kiln inlet was 10 degrees centigrade, while the temperature of the waste gases was 350 degrees centigrade. The present kiln is a little short to operate at the most efficient capacity, because the reducing zone is not quite long enough to correspond to the rest of the kiln. In contemplating the present experimental kiln as a model from which to develop a commerical unit, it may be regarded as having three zones, viz: a preheating zone, a reducing zone, and a cooling zone. It is assumed that there would be little or no waste of combustible gases in a commercial kiln, and that the temperature of the waste gases would be about 150 degrees centigrade. Considerable heat from the waste gases would be used in drying wet concentrate charged into the kiln. Under properly adjusted operating conditions, the carbon actually required for the experimental kiln was about 308 pounds per ton of ore.

The Selection of Fuel Oil for Diesel Engines.

By T. B. Leech, '22.

Since the Diesel engine has come into permanent and practical use it has brought with it individual problems. One of these deals with the nature of the fuel to be used. Frequently one hears of a Diesel engine, with no apparent fault in design, operating perfectly on one shipment of fuel, and on another it will give constant trouble. This causes one of two results: either the particular make of engine gets a bad reputation, or the company from which the oil was bought loses a customer. In either case the result is very unsatisfactory to the engine operator.

In isolated mining districts, especially, and in almost any engineering work where Diesel engines are used, it is difficult for the consumer to return an unsatisfactory oil and to obtain another shipment. The whole trouble can be remedied, if operators will answer the two following questions: "What kind of oil should be used to obtain the maximum efficiency? How can the requisite properties be determined?"

In giving the following tests it is the aim to aid the engine operator, the reputable oil companies, and the manufacturer of oil engines. When a consumer knows exactly what he should buy he will specify that particular grade of material in purchasing. In consequence he will receive satisfaction from his oil purchased, and in turn be pleased with the particular make of engine which he is using. At the same time the oil dealer, or manufacturer, will receive a great many less complaints—no small item in itself, and the unscrupulous dealer will be exposed.

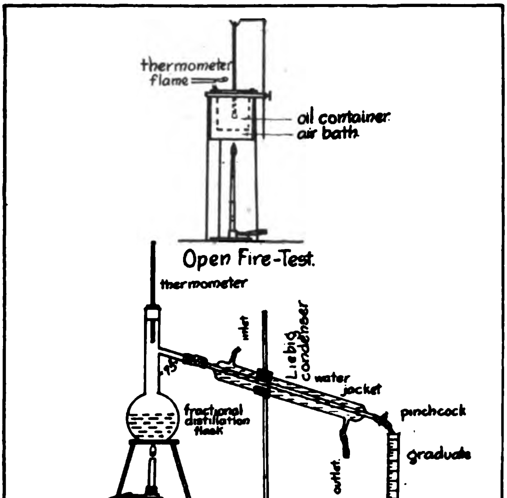
Diesel engine fuel specifications are simple, but an oil to be efficient, must conform to them in every respect. In giving the following specifications the idea has been kept in mind that, while the operators must definitely determine the value of the oil as a Diesel engine fuel, the tests themselves must be simple and inexpensive to perform. It is assumed that in the majority of mining camps, and other places where there are Diesel engine installations, that there is no petroleum laboratory.

The actual laboratory methods of testing fuel oils are given so that the operator may be able to determine for himself, whether or not a shipment is satisfactory. When a shipment is received from one of the large companies, no tests need be made, providing specifications have been furnished them, as a large oil company sells goods on merit and seldom, if ever, substitutes in an order.

The protection afforded by these tests is needed when purchasing from a small dealer, who, in order to hold the order, may ship a substitute or inferior grade of oil when the product demanded is not on hand.

The simplest specifications are as follows:

1. Oil, ordinarily, should not be heavier than 20° Bé.
2. Flash-point should never be below 170° F.
3. *90% of oil should distill over below 660°F. or 400°C.
4. *Distillation should be continued until the residue is coked. This coke should not weigh more than 0.5 gm.
5. Oil should contain no free acid.



Arrangement of Fractional Distillation Apparatus

6. Sulphur content should be below 2.5%.
7. Water and mechanical impurities: water must be below 0.5% and mechanical impurities must be entirely removed.
8. Oil should contain no measurable quantities of ash.

Methods of Making Determinations, and Relative Importance.

Gravity Method.

Gravity may be determined in a direct manner by the use of any one of the standard American hydrometers. These hydrometers are graduated on the Baumé scale at 60°F. If the gravity is taken at a different temperature a correction, as indicated on the hydrometer, should be made. Gravity is important in this case only to the extent to which it furnishes an index to fluidity. Most California and Mexican oils with a Baumé gravity below 20° are too viscous for use in Diesel engines.

Flash-point Method.

A flash cup, known as the Cleveland type, supplied with an air lath is both fairly accurate and inexpensive. [See sketch.] This cup is filled to within 0.25-inch of the top. A thermometer is entirely immersed so that the bulb is in the center of the cup without touching the bottom. Heat is applied, by means of a burner, so that the oil temperature is raised 5°F. per minute. As the flashing-point is approached, a test is made for every three degrees advance in temperature by passing a test-flame across the top of the cup, horizontally, near the thermometer. †The test-flame should be about 5 mm. long. The temperature at which the gas emitted above the surface of the oil first flashes is taken as the flash-point.

The flash-point should never be below 170°F. This figure shows conclusively that the oil contains no fractions which would, at the temperature common in Diesel engine plants, volatilize and form an explosive mixture, thus introducing an extraordinarily dangerous fire-hazard. [To the buildings.]

Distillation Method.

In this case the distillation may be conducted by what is known as the "rapid method." By this method 100 cc. of oil is charged into a 150 c.c. fractional distillation flask [see sketch] with a side tube extending downward at an angle of 75° from the middle of the neck. A thermometer is inserted in the top of the flask, so that the top of its bulb is just level with the bottom of the side vapor-tube. This vapor-tube is connected to a Liebig or Saybolt water-cooled condenser, from which the condensate may drop into a graduated receiver.

* Specifications drawn by Roumanian Section, International Petroleum Commission, 1912.

† The test flame is best obtained by using gas, lighted at the end of a copper tube, drawn to a point and with an internal diameter, at the point, of about 1-32-inch. Where gas is unobtainable the test flame of the requisite size may be obtained in the following manner: Ordinary jute wrapping twine may be dampened and rapidly dried by passing over a flame. This tends to make the twine stiff. It may then be cut into lengths of about five inches. One of these, when ignited, will cause a short flame for sufficient length of time to make a test.

A Bunsen or other burner should be used to raise the temperature. The complete time of distillation should be about twenty-five minutes.

The temperature of the initial boiling-point of a Diesel engine fuel is of no special value as the flash-point insures the initial boiling-point being sufficiently high. About 90% of the initial charge must distill over below 660°F. or about 400°C.

The mere fact that 90% of the fuel oil distills below 660°F., insures its volatilization, and consequently the complete combustion, at the temperature of the engine cylinders. When much over 10% of all remains undistilled at 660°F., it means either that the combustion of the residue will be so slow that it will delay the return of the piston to the compression position, or it will actually form a deposit in the cylinder, with no explosion whatsoever.

Coking Method.

In order to obtain the percentage of coke, the distillation is continued until all volatile parts are driven off, leaving a solid residue. This should not weigh more than 0.5 gram. although some especially equipped engines will run on an oil having a coke content of as high as .5%

Coke combines with the lubricating oil, filling the space between piston rings and coating the piston itself with a hard formation. This renders lubrication ineffectual and increases the wear on the cylinder walls.

Almost any oil that leaves a high coke content at 660°F. cracks at some temperature between 550°F. and that limit, leaving the coke as a result of driving off the volatile substance from the free carbon formed during cracking. Such an oil is totally unfit for use as a Diesel engine fuel.

Free Acid Method.

Unless the oil is a refined product it is extremely unlikely that it will contain any free mineral, and if it is a refined product, the acid may be tested for as follows: mix in a test tube 10 c.c. of water with an equal amount of the oil to be tested. Shake well and carefully note the color. Add a few drops of dilute methyl orange, shake well, and again note color. Any pinkish coloration of either the water or oil indicates free acid.

Free-acid will act in time upon any metal with which it comes in contact. It should, therefore, be excluded, by specification, from any Diesel engine fuel. At the temperatures in the cylinders, the corrosive action is considerable.

Sulphur (Robinson's Method).

Solutions required:

No. 1. A dilute aqueous solution of methyl orange.

No. 2. A solution of sulphuric acid, 1 cc. equal to 0.001 grams of sulphur.

No. 3. A solution of sodium carbonate equivalent to the sulphuric acid.

About 5 or 6 cc. of the oil to be examined is poured into an Erlenmeyer flask, which has about 15 to 20 cc. capacity and which contains a wick passing through a glass tube, held in place by a cork. The flask, with the cork and wick, is then weighed, the second decimal place being sufficiently accurate. It is then placed under the small tube, which is connected with the absorption apparatus, one limb of which contains broken glass rods, and into which 5 cc. of the standard alkali solution has been run. The absorption apparatus is connected with the suction when all is in place. The suction is turned on and the wicks lighted. [The suction may be produced by a water-aspirator.]

The suction draws all the products of combustion through the absorption tube. The sulphur contained in the oil is burned to SO_2 and SO_3 and is absorbed by the sodium carbonate solution. The oil is allowed to burn about thirty minutes until 2 or 3 grams are consumed. The tube over the flame is rinsed into the absorption tube, a few drops of methyl orange added, and the excess of sodium carbonate titrated with the standard sulphuric acid, and the amount of sulphur calculated.

2-n glass beads should not be used, as they are made of soft glass which is soluble enough to vitiate the analysis.

This method does not give accurate results. For close work it is better to burn the oil in a bomb, or to use the method of Carius, which uses fuming-nitric acid as an oxidizing agent in a glass bomb.

Any sulphur contained in a fuel oil is burned to dioxide and thence oxidized to the tri-oxide. This, however, exercises no harmful effect on the engine provided that the exhaust pipe is not cooled enough to condense the water vapor formed by the combustion. If the exhaust is cooled to a water-condensing temperature, sulphuric acid is formed which corrodes and eats the exhaust. Mexican oxide oils are practically the only oils marketed in this country having a sulphur content of over 2.5%. Even they may be successfully used provided the exhaust is made of cast iron instead of steel, so that it will offer greater resistance to the sulphuric acid.

Water.

Water which is mechanically held in the fuel oil will settle to the bottom of any container, if the oil remains undisturbed for a few hours. It may then be gauged or measured.

There are three factors entering into the consideration of free-water in fuel-oil. First, should the fuel tank be so placed that this water is all drawn upon at one time, it will displace the oil in the valves of the engine, so that it will cease to operate. Second, the purchaser should not pay for water nor the transportation of it.

‡Herbert Haas, says: "Fuel oils should not carry more than 5 per cent of water, and a greater water content should be subject to a penalty."

Third, water which is emulsified with oil, even in very minute quantities, lowers the heat value of the fuel. Unlike the oil, the water consumes heat, in its vaporization. The emulsified mixture also requires a much higher cylinder temperature for complete combustion.

Mechanical Impurities.

In general, mechanical impurities come from storage tanks that have been used too long without cleaning, or from dirty tank cars. Such impurities can be removed by strainers and filters in the power-plant system. Oils containing mechanical impurities tend to clog the valves. Should any solid particle pass through the valves it will, of course, tend to score the cylinder walls and pistons. In consequence no Diesel engine fuel should ever contain mechanical impurities.

Ash Method.

One hundred grams of oil, upon being evaporated to dryness, should leave no weighable quantities of ash. The Roumanian section of the International Petroleum Commission in 1912 specified that "upon evaporating 50 grams of any fuel oil, in a platinum dish, no weighable quantities of ash must remain." It is not absolutely necessary to have a platinum dish if the best of porcelain dishes is used. The quantity of oil evaporated has generally been increased from 50 to 100 grams in order to make ash detection easier.

Ash is wholly composed of iron and aluminum oxides and silicates. These materials will all enter the lubricating oil, in much the same manner as ash. They are all of great hardness and will cause excessive cylinder wear.

‡ U. S. Bureau of Mines, Bulletin 156, The Diesel Engine.

General Discussion.

In giving the foregoing tests it has been the aim to select methods which obviate the use of expensive apparatus. For this reason, the viscosity test has been omitted. Viscosity is merely a relative property of oil, which changes with the temperature. If the oil is satisfactory in all other respects, an operator can judge, without a viscosimeter, whether or not the oil is sufficiently fluid to readily pass the main storage tank to the cylinders. When applied to Diesel fuels, the gravity determination helps in judging whether an oil is too viscous for use.

The determination of paraffine and asphalt percentages has been omitted, as unnecessary. Paraffine tends to make an oil viscous at low temperatures. Heating, however, will render the oil sufficiently fluid for use. The asphalt content might cause gumming of the needle-valves, but at the same time a high asphalt content invariably gives a high coke content. If, therefore, the coke content is within the stated limit the asphalt test is automatically eliminated.

It might appear to some that a test of calorific value should be included in these tests, but this test requires expensive apparatus. Almost all of the American oils which are within the specified limits for sulphur and water will contain the required 18,000 B.T.U. per pound.

There is today a refined product sold by most of the larger manufacturing oil companies which admirably meets all demands for a Diesel fuel. Where the operator is inexperienced, or where the installation is small, this refined fuel should be obtained. **For small installations the slight increase in cost for this refined fuel can be neglected in consideration of the saving in upkeep and increased efficiency.** In large installation the refined fuel is not necessary because larger engines will run efficiently on poorer grades of oil.

Large operators, therefore, may find it more economical to buy cheap, but tested fuel, at the expense of a slightly increased maintenance.

POTASH.

At Dunbar, Pa., a blast-furnace of 200 tons daily capacity produced 1 ton of potash when running on a basic iron-ore charge; 2 tons when manufacturing ferro-manganese. The potash contained 30 per cent K_2O. It was recovered from the blast-furnace by electrostatic precipitation by the Cottrell Process.

Statistical Treatise on Gold and Silver*

By C. Erb Wuensch, '14.

Graphs by W. B. P. Case, '20; E. B. Bunte, '20; and M. L. Sisson, '20.

Object.

The purpose of these notes and graphs is to present in a concentrated form general information and statistics relative to the production of gold and silver. We hope that this data will enable our readers to obtain a true perspective of the status of the gold and silver industry, and that it will, also, stimulate thought and action that will be beneficial to the solution of the "gold problem."

Mineralogical Notes.

The following ore and gangue minerals are of most importance in ore occurrences:

Gold Minerals.

Name	Composition	Au %
Native	Au	100
Calaverite	Au Te	31.5
Sylvanite	(Au Ag) Te_2	variable
Petzite	$(Au\ Ag)_2$ Te	variable

Mechanically mixed with pyrite and other sulphides ....variable

Mechanically mixed with limonite and other oxides and carbonates variable.
Gold is occasionally found in stibnite, cinnibar, keolin, sulphur and rare earth minerals.

Silver Minerals.

Native	Composition	Ag %
Argentite (silver glance)	Ag	100
Pyrargyrite (ruby silver)	Ag_2 S	87.1
Proustite (light ruby silver)	3 Ag_2 S, Sb_2 S_3	59.9
Hessite (telluric silver)	3 Ag_2 S, As_2 S_3	65.5
Stephanite (brittle or black silver)	Ag Te_2	46.3
Cerargyrite (horn silver)	5 Ag_2 S, Sb_2 S_3	68.5
Tetrahedrite (gray copper)	Ag Cl	75.3
Steel galena	Pb S	variable

Mechanically mixed with pyrite and other sulphides.
Mechanically mixed with limonite and other oxides and carbonates.

Gangue Minerals.

In order of frequency of occurrence are: Quartz, bayrite [in veins], calcite, limonite, manganese oxides, feldspars, various oxides, rock-forming silicates, garnet, fluorite, rhodocrosite.

Geological Distribution.

Gold and silver have been deposited in all geologic periods. In certain localities these metals are frequently genetically related to definite formations and geologic processes peculiar to that province. Tertiary quartz veins yield the largest proportion of the world's gold and silver production.

*Compiled from Mineral Industry, Peele's Mining Handbook, W. R. Crane's Gold and Silver, et al.

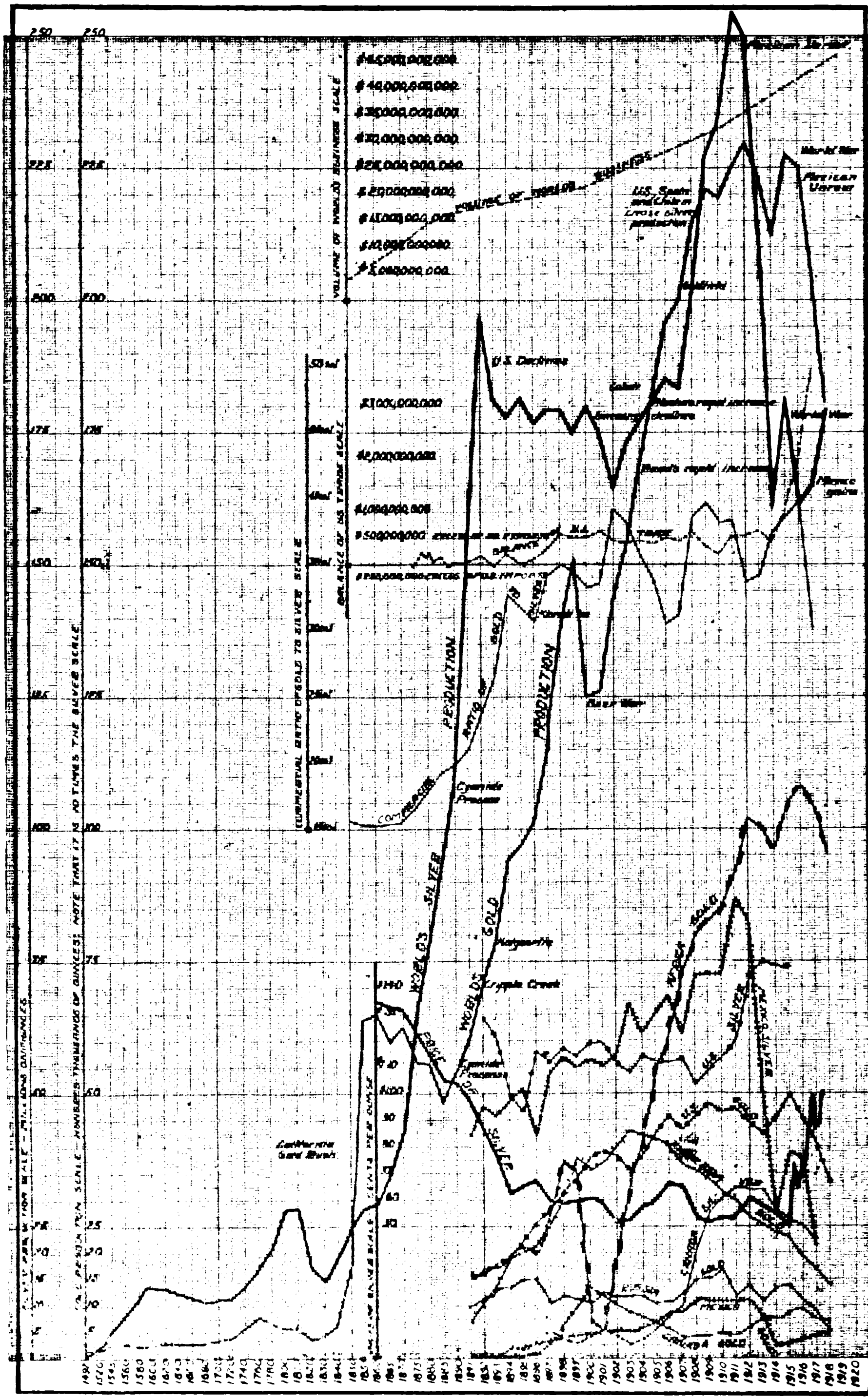
Classification According to Metallic Contents.

1. **Placer or Gravel Deposits.**—Probable 25% of the gold production is derived from these also about 2% of the silver. The silver is usually alloyed with the gold.

2. **Free Gold and Silver or Pyritic Ores in Quartz Gangue.**—May also contain small amounts of the sulphides. Probably 60% of the gold and 25% of the silver production obtained from this type of ore. Tellurides and fluorite are common in these. Amenable to cyanidation or wet-gravity concentration.

3. **Copper Ores Containing Gold and Silver.**—About 30% of the production of silver and 5% of the production of gold is derived from the source. These are smelted, either before or after concentration, and the gold and silver is obtained as a sludge in the electrolytic refinery of the copper.

4. **Lead Ores Containing Gold and Silver.**—Probably 40% of the production of silver is obtained from these ores. Some ores are remarkably free from gold, whereas others [especially if small amounts of other sulphides are present] contain important amounts of gold. These are smelted, either be-



Graphs of Gold and Silver Statistics.

Types of Deposits.

	Kind	Approximate Percentage of Occurrences	Remarks
1.	Veins	60	Includes fissure lode, linked, gash, and other types of vein structure.
2.	Contacts	10	Includes deposit found along the contact of two igneous or an igneous and a sedimentary formation.
3.	Detrital	10	Placers; especially gold. Ancient channels.
4.	Impregnations and replacements	8	Includes shear-zones, breccias, slates, schists.
5.	Bedded and blanket	7	Includes conglomerates, sandstones and limestones, etc.
6.	Chimney and volcanic stocks	4	Those related to volcanic activity.
7.	Hot Springs	1	Those associated with quicksilver deposits.

fore or after concentration, and the precious metals are recovered in the process of refining.

5. **Zinc Ores.**—Those containing over 30% zinc usually are an unimportant source of the gold and silver production. As the zinc content decreases, and the proportion of other sulphides increases, so do the precious metal content. The latter are usually concentrated into various products.

Distribution and Frequency Occurrences in Various Kinds of Rocks.

Gold and silver are not peculiar to any kind or class of rocks. About 40% of the deposits are found in igneous, 40% in metamorphic, and 20% in sedimentary rocks. Of the igneous rocks, most of the occurrences are in the acid members, such as granites, quartz-porphyries and rhyolites.

No such chemical preference is shown in the metamorphic rocks of the metamorphic occurrences, 25% are in slates, 25% in basic schists, 25% in acidic schists, and the remaining 25% in breccias quartzites and metamorphosed limestone.

Of the sedimentary occurrences 70% are in conglomerates and the remaining 10% in sandstones and shales.

Metallurgical Pressures.

Name	Percentage of World's Production Au	Ag
Cyanidation	60	20
Amalgamation	25	5
Smeltery [before and after concentration].		
Recovered in process of refining the base metals	15	75

Mining Methods and Economics.

From the above given data, it can be seen that about 25% of the gold and 2% of the silver production is obtained from placer mining and the rest from ore mining. It therefore might be of interest to give some figures on the cost of this mining and also of the milling operations, and to shift the proportion of this cost that is involved under the headings of labor, supplies and power. All costs apply to normal times.

Placer Mining.

(1) Hydraulicing—

(a) Cost varies with nature of gravel, the amount and pressure of water, and nature of topography. Varies from 2c to 15c. Average 4 to 6c. Duty of miner's-inch of water varies from 1 to 7.5 cu. yds. of gravel. Average 3.5 cu. yd.; 90 to 95% gold recovered.

(b) Labor ....40 to 50% } of cost
Supplies ......50 to 60% }

(2) Dredging—

(a) Cost varies with depth, size and texture of gravel. Also with nature of topography, amount of water, geographic location, source of power, size and type of dredge. Varies from 4 to 15c; average 6 to 9c.

(b) Labor ....40 to 50% }
Supplies ......20 to 35% } of cost
Power ....20 to 35% }

(3) Drifting [Ancient Channels]—

(a) Varies with topography of channel, nature and thickness of gravel, amount of timbering required, and amount of water encountered. Varies from 50c to $3.00. Average 75c to $1.25.

(b) Labor ....50 to 70% }
Supplies ......30 to 50% } of cost
Power .... 0 to 5% }

Ore Mining.

1. **Narrow Veins.**
(a) Cost varies with width, dip, depth, uniformity of grade, condition of walls, amount of water, hardness and geographic location. Varies from $4.00 to $10.00 per ton. Average $6.00 to $8.00.
(b) Labor ....60 to 65% } of cost
Supplies ......30 to 40%
Power .... 5 to 10%

2. **Wide Veins.**
(a) Cost varies with conditions of walls, depth, system of mining, hardness, amount of water, mine equipment and geographic location. Varies from $1.00 to $5.00 per ton. Average $2.50 to $3.50 per ton.
(b) Labor ....50 to 65% } of cost
Supplies ......20 to 35%
Power .... 5 to 15%

3. **Blanket Veins.**
(a) Cost varies with condition—hanging walls, dip, thickness, hardness, amount of water, tonnage mined, and geographic location. Varies from $2.00 to $5.00. Average $3.00 to $4.00.
(b) Labor ....50 to 60 } of cost
Supplies ....20 to 30
Power .... 5 to 10

Monetary Considerations—Gross Amount and Net Amount of Gold Per Capita.

1. Gross amount per capita is the total amount of gold per person, whether hoarded or in use.

2. Net amount per capita is the total amount of gold per person that is actually in circulation or in the banks and subject to use. This amount varies greatly. It is dependent upon the sentiment of the people; as they lose confidence in business conditions the amount hoarded increases. The amount hoarded varies from 20 to 40% of the total gold reserve of the world.

Gold Movements.

Four general factors:

1. From mines to markets.
2. Distribution to various consumers, mints and the arts.
3. Readjustments to settle domestic business transactions.
4. Movements to foreign countries, according to Balance of Trade.

Gold and Credit.

There is approximately ten and one-half billions of dollars' worth of gold in the world. Of this amount the United States has about one-third. Statistics show that about 60%, or six billion dollars' worth of gold is only in use, the remainder is hoarded or used in the arts. The bank credits supported by the net amount of gold in circulation aggregates about thirty billions of dollars, and the volume of the world's business amounts to over four hundred billions.

Irving Fisher states that the ratio of gold to credit has risen in the United States from 9.6% on June 30, 1914, to 15.3% on June 30, 1918, due to the fact that the war has changed the United States from a debtor to a creditor nation; the movements of gold into the United States in accord with the metamorphosis has consequently been enormous.

Gold and Prices.

Many economists maintain that high prices have always been, and at present are, due to increased gold production. W. R. Ingalls has shown by statistics that no such relationship exists.

The chief factors influencing prices are:

1. The economic waste due to war.
2. Tremendous growth of our mineral, agricultural, lumber, grazing and other natural resources.
3. Increased volume of world trade, with expansion of foreign markets and construction.
4. Because of the increased standard of living, with attendant luxuries.
5. Inflated credits.
6. Increase of gold production only, insofar as it temporarily makes money plentiful, and thus induces uneconomic speculation.

Political and Social Factors.

Alex. Dana Noyes, in his book, "Forty Years of American Finance," traces the results of political and social influences. In general, any charge in the monetary standard or banking system causes dissension between bankers, manufacturers, investors, and laborers. The reason for this is that such a charge inevitably favors one or two classes at the expense of the others. History demonstrates that any legislation which favors strengthening the gold standard meets with universal approval.

This is of vital importance because when such a condition exists we have universal confidence, whioh, after all, is the key-note to business prosperity.

History also shows that wars are invariably followed by a period of religious indifference and immorality, which is conducive to waste, and other uneconomic practices. A period of depression finally results. After this human interests are again aroused in religious activities, accompanied by moral and economic methods of living. The result is a period of prosperity.

Other Costs.

Many other costs such as pumping, hoisting, crushing, concentration, cyanidation, flotation, smelting, hauling and marketing should be included, but because of the number of factors involved in each of these, it will be impossible to deal with them in a treatise of this nature. In addition to these there is the general and overhead charge. This varies from 10 to 25 per cent of the total cost of production.

Conclusion.

In conclusion it might be well to call attention to the fact that 85 per cent of the mines are discovered by prospecting, 10 per cent accidentally, and 5 per cent by recognizing a new mineral in a known deposit, or assaying for the precious metals where they are least suspected of occurring. It, therefore, appears that if gold and silver mining is to prosper that more intensive methods of prospecting and development must be resorted to. If the large operating companies do not change their conservative policy of considering only developed mines, some sort of state legislation to foster development will have to be enacted. There are many prospects worthy of development, but unfortunately they are in the hands of people who have not the capital for further work.

IDLE HOUR

CARE OF RUBBER TRANSMISSION BELTS.

Cutting—Make edges true by using a steel square.

Lacings or Fasteners—Whenever possible, use an awl instead of a punch to make the holes. The punch by cutting out a certain amount of duck reduces the tensile strength of the belt. When necessary to use the punch, therefore, the holes should not be made larger than absolutely necessary.

Lacing holes should be in parallel lines straight across the width of the belt. If they are not in straight lines, the tension strain on the lacing is not equalized and may easily result in trouble.

Seam—Do not run seam side of belt next to pulleys.

Belt Dressings—Avoid them as far as possible. If dressing is used, it should be a high-grade vegetable oil. Cheap mineral oil dressings are extremely harmful.

Oil—Save your belts from contact with oil if possible. Oil is an enemy of rubber and bound to cause some deterioration.—Goodrich Rubber Co. Catalogue.

PLATINUM.

Previous to the War, 90 per cent of the World's production of Platinum came from the Ural Mountains, Russia. In 1911, Russia produced 300,000 oz.; in 1916, only 78,674 oz.

The Choco District of Colombia, South America, increased from 12,000 oz. in 1914, to over 50,000 oz. in 1917. This district gives promise of surpassing the Ural Mts. production. Practically all of this output was obtained by the very crude method of panning by the natives.

GEOLOGIC PUZZLE.

It is a strange and puzzling geologic phenomenon why a gold-silver deposit is so invariably found in a quartz gangue whereas a copper deposit of identical structural and lithologic occurrence should contain a predominating limestone or basic silicate gangue rather than quartz or silica.

VALUE OF CROSS-CUTTING.

No matter what the surface indications may be, if you have an ore-deposit outcropping, it will pay you to cross-cut and search for blind-veins. Do not confine your prospecting to the one vein that outcrops.

MIGRATION OF OIL.

Geologic evidence indicates that most of the commercial accumulations of oil are derived from the distillation of the plant oil and animal remains contained in shales, and that this oil has migrated from these to rocks which form more suitable reservoirs. The most potent factors causing this migration are:

1. Differences in the specific gravity between oil and water. The oil, being lighter than water, accumulates at the crests of anticlines. It forms a strata superimposing the water.
2. Hydrostatic pressure of ground water.
3. Capillary attraction.
4. Heat gradient; convection currents are set up.
5. Earth movements insofar as they cause a change of water-level.

TECHNICAL REVIEW

GENERAL.

The New Price Revolution. By Irving Fisher. (Mining & Scientific Press, April 26, 1919.)

At present we are threatened with a widespread business depression, resulting from peculiar causes. The unsound conditions usually accompanying a business depression are absent. The main reason why business is not better is that most people expect prices to drop. Despite numerous price adjustments the general level of prices has shown little signs of falling. This is evidenced by price index numbers. The Author believes prices will not fall, but that we are on a permanently higher price-level.

The general level of prices is dependent upon the volume and rapidity of turnover of the circulating medium in relation to the business transacted thereby. The present monetary-system is like an inverted pyramid, the gold reserve forming the small base and bank notes and deposits the larger superstructure. Any increase in the countries' gold supply multiplies the amount of money placed in circulation with it as a base. The excess gold in this country is sufficient to increase our banking credits 70 per cent. Our currency is inflated in terms of the prices of 1913-1914, but is not inflated relative to the new level of prices.

The reasons why the general level of prices will not fall are:

1. Gold will not return to daily circulation.
2. No great outflow of gold through international channels.
3. Availability of the vast issues of War Bonds as a basis for future internal credit expansion.
4. Federal Banks could not, either by raising discount rates, decrease the volume of bank credit outstanding without serious banking depression.
5. No reduction of the outstanding credit.
6. The hostile attitude of labor to any reduction in wages.

The proper thing to do is to face actual conditions. High prices are here to stay and we must act accordingly, and continue with business. Otherwise disaster threatens. W. A. Conley.

Steam Economics in Simple Terms. By S. A. Worcester. (Eng. & Mining Journal, March 29, 1919.)

The many prevalent wastes in steam boiler and engine plants are pointed out and the necessary remedies are stated. Usually the simplest of adjustments and care are required and by attention to apparently trifling details much saving can be accomplished.

A common waste is from the use of a too low a boiler-pressure. It is false economy to carry a low boiler-pressure. The fuel consumption is not decreased, but for the work done is actually increased.

The adjustment of the valve gear is important so as to obtain as great a cut-off as possible, utilizing the expansive force of steam. Where hand operated cut-off valves are provided the use of the throttling control is very inefficient, and should not be used, but left opened and the engine run by means of the hand cut-off.

With large engines, having an automatic cut-off, the mechanism should be properly adjusted. A noisy exhaust usually means waste. A continuous roaring exhaust without distinct puffs for each emission of steam indicates leakage in valves or piston or contractions in the exhaust pipe or connection. By listening to the exhaust when the engine starts from rest the hissing sound (if leakage) is very different from the cough of exhaust when running and leakage can be told from contraction with ease in this manner. W. A. C.

Magnesite on the Island of Margarita. By Chas. F. L. Caracristi. (Eng. & Mining Journal, April 12, 1919.)

The Island of Margarita is 11 miles off the coast of Venezuela, 190 miles N. E. of the port of La Guayra. The Island is a post-Eocene intrusion, with many rugged peaks and mountainous country over a large portion of the Island. The western extremity is composed of basic igneous rocks, rich in ferro-magnesia minerals, as serpentines. Upper Cretaceous sediments have been uptilted by the intrusions and have formed a large anticline. Seepages of oil are found and the prospect for oil is also favorable. The magnesite is found in veins and seams in the serpentine, similar to the California deposits, and in addition deposits of large area are found in troughs, probably ancient stream-beds which have been filled with magnesite derived from the decomposition of the igneous and serpentine rocks.

About 3,200,000 tons of magnesite is

available. The mineral is found in a very pure condition, the mine run carrying about 47.13 per cent MgO and 1.34 per cent combined iron, silica and alumina. W. A. C.

Operations and Properties of the Texas Gulf Sulphur Company. (Eng. & Mining Journal, March 29, 1919.)

The sulphur deposits of the Texas Gulf Sulphur Company at Matagorda, Texas, are found at a depth of 800 to 1,000 ft. The Matagorda dome lies at the center of the deposit and is about 4,000 ft. in diameter. The sulphur is found as a horizontal layer, overlain by unconsolidated sediments. The sides of the dome dip steeply (45° or more) and the sulphur-bed thins out near the sides of the dome. Beds of salt and gypsum are associated with the deposit and boreholes have shown a reserve of 10,000,000 tons of S.

The Frasch method of extracting the sulphur is used. Steam is used to heat water which is pumped underground, melting the sulphur; and the molten sulphur is then pumped by air-lift to the surface whence it flows into an enclo-ure, later to be loaded by steam shovels into railroad cars and shipped.

No refining of the sulphur is needed. Fuel efficiency is low, about 3 per cent. Water consumption, 2,000-4,000 gal. per ton of S recovered. 14 oil fired Stirling boilers supply the steam for heating the water.

The seepage of water, and local collapses of the ground as the sulphur is withdrawn renders the operations uncertain as the exploitation continues.

W. A. C.

The United States Ammonium Nitrate Plant, Perryville, Md. (Chem. & Met. Eng., April 1, 1919.)

The new plant of the Government, built last spring, is described for the first time. Ammonium nitrate is manufactured by the double decomposition of Chilean saltpeter, and ammonium sulphate. The different manipulations together with a description of the plant will be found in this interesting paper.

W. A. C.

Report of the Alien Property Custodian on the Metal Industry. (Chem. & Met. Eng., April 1, 1919.)

The April 1st number of the Chemical and Metallurgical Engineering contains an abstract of the report of the Alien Property Custodian's report dealing with the activities of the German controlled firms in controlling the World's metal market, accompanied by several graphs showing the Triumvirate's ramifications.

While Germany has never been a great producer of metals, yielding only 3 per cent of the World's copper, 28 per cent of the refined zinc and 10 per cent of the lead, she exercised an almost complete control of the zinc and lead markets and was an important factor in the World's copper market. The secrets of this control lay in that the German metal houses have always acted in concert in the purchase and sale of zinc and lead ores and the refined metals and in the almost unlimited credit placed at their disposal by German banks.

The Triumvirate was composed of three German parent firms, with their numerous offspring, namely:

The Metallgesellschaft, of Frankfort.
Aron Hirsch & Son, of Halbergstadt.
Beer, Sondheimer & Co., of Frankfort.

Each company had a branch in the United States at the outbreak of the European war, consisting of The American Metal Co., L. Vogelstein & Co., Beer, Sondheimer & Co., and the control of the Minerals Separation North American Corporation. These companies controlled a number of mines, smelteries, refineries, and acted in concert to manipulate the metal market.

As a result of the Alien Property Custodian's activities the entire business of the firms has been taken over with the exception of the American Metals Co., of which 49 per cent of the stock was seized. All the stock of these corporations together with their control will find their way into American hands, and the elimination of German influence is to be expected. W. A. C.

The Use and Abuse of Crucibles. By A. C. Bowles. (Mining & Scientific Press, April 12, 1919.)

The troubles experienced with crucibles are generally due to improper care. Crucibles before being used should be properly annealed, either in a special drying furnace or on top of the crucible furnace. Precautions to be observed in annealing are:

The temperature must be about 250°F.

The temperature must be raised gradually.

The highest temperature must be maintained for some time.

The crucible after annealing must go into a fire with a temperature above 250°F.

Care should be taken that the crucible tongs are of the proper size and shape. In using oil furnaces the flame should never play on one side of the crucible.

Wet coke should not be used as the steam formed cracks the crucible.

Careful attention to storage, annealing and treatment of the pots will greatly lengthen their life. W. A. C.

Australian Iron Ore Resources. Information from Official Sources. (The Mining Magazine, March, 1919.)

The iron ore deposits of West Australia are probably some of the largest in the world, but owing to their geographical locations, and to the fact that no coal has yet been discovered in the state, they have remained undeveloped. Up to the present time the deposits have been worked only for obtaining the iron ore as a flux for lead and copper smelting.

Broadly speaking the ores may be divided into two classes:

(1) The ores as associated with crystalline schists and other allied rocks.

(2) Superficial deposits of limonite (laterite ore) which occupy extensive areas in many and widely separated portions of the State, and the soft, porous deposits of bog ore of comparatively recent origin.

The ores of class (1) are big for the most important, and are best developed in the murchison district. The chief deposits are on those of Wilgi Mio (Wild Range), Mounts Hale, Taylor and Matthews, and Gabanintha. In addition to these deposits, iron-bearing schists ore are found in almost all parts of the Murchison gold fields, and in numerous other areas of West Australia.

The deposits consist of highly inclined beds, lands, and lenses of almost pure hematite, and magnetite, or mixtures, in all proportions of hematite and quartz. The more silicious bands sometimes have a width of 650 feet.

The Wilgi Mio in Murchison goldfield is situated on a ridge along the south side of the Weld Range. The deposit is of almost pure hematite. It is from 150 to 200 feet in width and in places rises to a height of 400 feet. The lode dips almost vertical. Sulphides are not likely to be met with above the ground water level, which is 60 feet below the surface of the plain. The amount of ore actually in sight is said to be between 26 and 27 million tons.

These deposits are undoubtedly some of the richest in the world. The ore is of an unusually good grade. An average sample would run about as follows:

Fe	63 to 69%
SiO_2	1 to 3%
P	.05 to 09%
S	.025 to 035%

Many of the deposits of the Murchison district have been described. The most important of which are Mounts Taylor, Hale, and Matthews deposits, Mont Narryer deposit, and the Gabanintha deposit.

There are several iron ore deposits in Tasmania, the most important of which is the Blythe River iron ore deposit.

This deposit consists of a conformable layer of hematite of varying quality, in a formation of cambro-silurian slates and sandstones which have nearly a perpendicular dip. The ore is exposed to a width of from 100 to 150 feet. The deposit is very extensive. It has been estimated that there are 23,000,000 tons of ore above the level of the Blythe River. Considerable development work has been done to find out the character of the deposit at various depths. The ore taken from various tunnels runs from 46 to 68% iron, and from 1 to 35% silica. There is very little difference in the grade of the ore taken from the different tunnels.

The iron ore deposits of New South Wales have been developed to a very great extent. This is due to the close proximity to coal and limestone deposits.

The Carcoar deposit of New South Wales furnishes practically all of the ore used by the iron smelting works of G. & C. Hoskins, Limited, of Tethgow. The ore of this deposit is of a lower grade than most ores found in the Murchison mining district. The deposits are very extensive, being from 100 to 150 feet thick, and from 3,000 to 4,000 feet long. They sometimes form ridges 40 feet high at the outcrop. The Iron Duke mine is the largest producer of iron ore in the district. There are two kinds of ore in these deposits.

1. The oxidized ore consists of hematite and limonite.

2. The unoxidized ore, or primary ore, consists of hematite, speculants, and some magnitite. O. H. M.

MINING.

Mining—An Investment, a Speculation, or a Gamble. By T. A. Rickard. (Mining & Scientific Press, April 19, 1919.)

One of the most masterful discussions of mining that has appeared in our technical literature, is this article by Mr. T. A. Rickard. Money can be employed for for investment, speculation or gambling, the definition employed depending largely upon the individual. Mining is essentially a speculation, but the risk involved is not unreasonable and can be diminished by knowledge and experience. The total elimination of risk is contrary to the spirit and false to the history of mining. The attempt to find mines that would involve no risk has crippled the industry and resulted in the failure of many so-called "exploration" companies.

The finding of ore, the chief attraction and that which pays the largest reward, is kept in the back ground.

The Rand has shown that mining is no investment. Money was made on the Rand in the development stage but as a gilt edge investment in over-capitalized companies the decline of shares in value in the last seven years of $204,000,000 speaks for itself.

The idea of minimizing risks and limiting possibilities would cause any industry, as well as mining, to wither. The thing to do is not to get rid of the essential risk but to require a rate of profit proportionate to it. The risks of mining should not be increased by poor management but the mine should be put on a business basis. Well conducted mining ventures meet with as great a success as any manufacturing enterprize.

"I make no apology for mining; it has been—and still is— a glorious adventure for the youth of the world, for those young in spirit as well as in body."

W. A. C.

Operations at the Zinc-Camp—Arkansas. By Tom Shrias. (Eng. & Mining Journal, April 5, 1919.)

Zinc-Camp covers an area of about ten square miles in North Boone County, Ark. The region consists of horizontal limestone beds, carrying deposits of zinc. The zinc mined is largely calamine, although deposits of sphalerite are known to exist. Most of the operators are small local concerns. Small mills at the mine, or local custom mills treat the ore, the metallurgy of which is simple. Crushing, followed by jigging and tabling constitutes the flow sheet.

W. A. C.

The Rise of Cost of Zinc Mining in Wisconsin. By W. F. Boericke. (Eng. & Mining Journal, March 29, 1919.)

The increased cost of mining is of special interest to zinc producers. The cost of mining zinc in Wisconsin has increased greatly since 1914. Labor increased 57 per cent, powder 103.6 per cent, supplies 60 per cent, power (electric) 32.5 per cent, or the unit increased cost of mining and milling 55.1 per cent.

Several solutions have been suggested as

1. Reduction in unit costs.
2. Rise in price of concentrate.
3. Increase in efficiency of mining methods.
4. Raise grade of ore by mining richer ground.

While much has been done in the saving of power, supplies, and in increasing the efficiency of labor (due to better machines and methods), the increase in comparison with the other factors has been small as far as total savings.

The operators have therefore generally been forced to mine the richer ground, and where this was impossible the mines have closed down, rather than exhaust the ore-reserves on an unprofitable market.

W. A. C.

Wolframite Mining in Bolivia. By G. F. J. Preumont. (Eng. & Mining Journal, April 5, 1919.)

During the last three years wolfram mining in Bolivia has become of importance. Wolframite is found along the line of the eastern Cordillera in quartz-veins associated with granite, quartzite or slate. The veins are much faulted and the mining has been confined to superficial workings. Most of the mines are at great altitudes and transportation is difficult.

The mines are worked by natives on a contract system. Little development has been done, but mining has been confined solely to the gouging of the richer deposits.

The concentrate, 60 per cent wolframite, is shipped to markets of New York or London.

W. A. C.

Tunnel Driving at Copper Mountain. By Oscar Lachmund. (Eng. & Mining Journal, March 29, 1919.)

The main haulage level of the Copper Mountain Mine of the Canada Copper Corporation at Princeton, B. C. was finished last September. The adit is 2,900 ft. long, 9 ft. high, 11 feet wide. Much heavy timbering (total of 350 ft.) was necessitated by nature of the ground. Drills used were Dreadnaught No. 60, mounted four on a horizontal bar. Variation of the drag-cut used, average holes 9 ft. in depth, to break 7 ft. round. Shots fires by spitting fuses. Tramming first by hand, mule, and as length increased, electric haulage. Mechanical ventilation by Connersville rotary blowers.

A mucking crew of three groups, 11 men to the shift, worked as follows: each gang took turns at shoveling, picking down material from muck pile, and in bringing up empty cars and moving the loaded ones.

Current daily wage was guaranteed, with additional bonus of $6.00 for all advances over 9 ft. Shift bosses and foremen shared in the bonus which worked satisfactorily to all concerned.

Tunnel was finished in 154 days, daily

advance, 19.3 ft. for each working day.

Material granodiorite.

Cost of tunnel, $35.36 per foot.

W. A. C.

The Guamoco District of the Republic of Colombia. By S. Ford Eaton. (Eng. & Min. Journal, April 5, 1919.)

This is the concluding article of a series first appearing in the March 22nd issue of the nEgineering and Mining Journal.

The difficulties of mining in the region are great. Transportation is the most difficult problem. All supplies, machinery and much of the food must be packed in by mules. Supplies must be ordered long in advance. Water-power is generally available, and can be used direct.

The natives are paid good wages but make poor workmen. Their morals are low and drunkenness is a common failing. Bonus work or contract work produce the best results.

All mining is done with 4 lb. single jacks. The veins are narrow and stulls largely used in timbering. Costs of mining , $14.50 per ton. Taxes and government assessments are reasonable and if the transportation problem is successfully solved the district's future is very promising. W. A. C.

The Prevention of Misfires. By Grant H. Tod. (Mining & Scientific Press, April 12, 1919.)

Many misfires are caused largely by a poor selection of materials. Suitable powder for the work, caps of sufficient strength and good fuses should be chosen. The explosives should be stored in a dry, well ventilated place, preferably at the surface. The caps and fuses should be carefully prepared. At least ¼-inch should be cut off of all fuse ends exposed to the weather and the cap crimped with a broad jawed crimper.

When loading the holes attention should be given to any exposed fuse ends. The fuse ends should be coiled up in the collar of the hole so as to be protected from flying rock when blasting. Holes placed in close proximity should be spaced with care so as to avoid driving water from one hole into the next when hole is shot. If water drills are used the same precautions should be used as when drilling in wet ground.

In untamped or insufficiently tamped holes, a little known, but very potent agent in causing misfires is the sweep of air returning following a shot, which may throw the powder primers from the hole, causing a misfire.

W. A. C.

Ventilation and Fire Protection in the United Verde Extension Mines. By Chas. A. Mitke. (Mining & Scientific Press, April 5, 1919.)

Ventilation:

The Company has three shafts and two raises, one shaft and one raise being used only for ventilation purposes. One suction fan of 40,000 cu. ft. per min. capacity is installed at the shaft, and a fan of 135,000 cu. ft. capacity at the raise. When the ventilation system is completed the mine will have 400 cu. ft. of fresh air per min. per man.

Fire Protection:

In the Edith shaft a spraying system is provided. The sprays and fire doors (operated by compressed air) are controlled from the surface. The Audrey shaft is concreted and the Little Daisy shaft is naturally wet so no protection is provided for these two shafts. A number of electric blowers, bulkhead material and fire-fighting equipment is kept on hand at all times. W. A. C.

Hemet Magnesite. By F. . B. Roney. (Mining & Scientific Press, April 19, 1919.)

The stoppage of imports of Austrian magnesite during the war greatly stimulated domestic production, especially in California and Washington. One mine. which has been producing steadily for the last several years, is at Hemet, Calif. The magnesite is found in narrow veins forming a stockwork in serpentine. The glory hole method of mining is used. Mine run is hand picked and the reject sent to the dump. From the picking room the magnesite ore goes to the washing room where it is washed to remove sand and clay and is then crushed and fed into an oil fired rotary kiln, which is heated to a bright cherry red. The magnesite is heated until the product weighs about 800 grams per liter and is then discharged and cooled on cement floors. From the cooling floor the material is shoveled on a conveyor belt, equipped with a magnetic pulley to remove any iron and sent to the crushing department, where the product is ground to –100 mesh and sent to market. The output of finished product is about 4 cars per month. W. A. C.

The Yerington District, Nevada. By Adolph Knopf. (Mining & Scientific Press, April 5, 1919.)

Geology of the District:

The oldest rocks of the district consist of about 4,000 ft. of Triassic andesitic and dacitic lavas, tuffs and breccias, upon which are deposited sediments, largely limestones. The whole series was folded and then intruded in Cretaceous time by large masses of quartz monzonite and granodiorite, accompanied by much faulting. Following a period of rapid erosion about 4,000 ft. of rhyolite lavas and 1,400 ft, of andesite breccia were poured out over the surface in Tertiary time. The district was again folded and extensively faulted and following continued erosion a series of basalt flows were poured out, and the district again subjected to a number of faulting actions in Quaternary time.

Ore Deposits:

The main ore bodies are contact-metamorphic deposits of copper. The gangue consists of pyroxene, garnet or epidote. Chalcopyrite associated with pyrite is the chief ore mineral. Average grade of ore. 2.75—6 per cent Cu. Deposits with one exception have been formed by the replacement of relatively pure limestones. The one exception consists of the replacement of brecciated garnetite and allied silicate rocks.

The main deposits are situated on or near fault contacts, the faulting and brecciation occurring previous to the formation of the ore-bodies. The ore-bearing solutions ascended along the fault planes replacing the limestones with ore and larger bodies of garnet and pyroxenes.

W. A. C.

The Gold Quartz Lodes of Porcupine, Ontario. By Ellsworth Y. Dougherty. (Mining & Scientific Press, April 19, 1919.)

The Porcupine District is about 100 miles northwest of Cobalt. Mining began in 1909 and many large mines have been developed since the discovery. The mining and milling methods are simple. The mines are worked largely by means of shrinkage stopes; little timber is needed and the mines are dry. Several of the mines have been worked as deep as 1,000 feet and the ore-bodies proven several hundreds of feet beyond by diamond drills. The ores are well adapted to cyanidation.

The gold is found in pyritic-gold quartz lodes in pre-Cambrian schists. The mineralogical association shows the veins to be of the high-temperature type. There are no evidences of enrichment or alteration. The ore-bodies occupy sheeted, fissile or well defined fault zones. The multiplicity of dislocations appear to be intermediate in character between true fault action and schist forming adjustments. The larger ore-bodies occur in parallel zones striking east-northeast. Since deposition of the ore the zones were subsequently faulted, but the dislocations were small.

W. A. C.

ORE DRESSING AND METALLURGY.

Metallurgy of the Oklahoma-Kansas District. By Robert W. Johnson and C. E. Heinz. (Eng. & Min. Journal, March 29, 1919.)

Practice of the District is always changing, but most of the mills have similar flow-sheets. The usual practice is to pass the mine run over 6-inch grizzlies, hand picking the oversize. The ore is then crushed in Blake crushers, followed by two sets of rolls, and screened by trommels to ⅜-inch. The undersize from the trommel is sent to Cooley rougher-jigs (usually 6 cells) which produce a middling product which goes to a Cooley cleaner jig (7 cells), and a tailing. Sands from the tails go to a sand tank (–2 mm.) and balance to waste. The cleaner-jig produces a lead concentrate, a zinc concentrate, a middling and tails. The middling is crushed and returned to the cleaner jig. The tails go to sand and chat-jigs, the tails from these last jigs going to the sand-tank and waste. Material from the sand-tank is sent over tables.

Ratio of concentration about 1 : : 16 or 17.

In some of the mills flotation units operate on sands and slimes from sand-tanks and Dorr thickeners with an increased saving. In present practice the flotation cell is limited to the fines (48-65 mesh), and unless present methods are discarded, flotation is limited.

Recovery 61 per cent of ZnS and PbS.

Tails average 3.83 per cent ZnS and PbS.

W. A. C.

Ball-Mill Operation. By E. M. Davis. (February Bulletin, A. I. M. E.)

A very good abstract of the article on Ball-Mill Operation appearing in the February number of the A. I. M. E. will be found in the April 12th issue of the Mining and Scientific Press.

W. A. C.

Unloading, Crushing and Screening at the Arthur Mill of the Utah Copper Company. By F. G. Janney. (Mining & Scientific Press, April 5, 1919.)

This article contains a detailed description of the unloading and crushing departments of the Arthur Mill of the Utah Copper Company. Briefly, the operations carried on are as follows: the railroad cars coming from the mine are dumped automatically in a rotating cradle, with a capacity of 30 cars per hour. Coarse crushing is done by gyratories, grizzlies dividing the mine run into plus 5 inch material and minus 5 inch, and each size crushed in separate crusher. Discharge from the two gyratories is screened by vibratory type screens into minus 1 inch and oversize. The oversize is crushed by Garfield rolls, screened and oversize returned to rolls until all is minus 1 inch, which is then sent to the fine crushing department. The oversize is crushed in closed circuit with 4 sets of rolls, 8 screens, and 3 conveyors.

W. A. C.

Sampling Practice at Independence Mill. By Claude T. Rice. (Eng. & Mining Journal, April 12, 1919.)

The Independence Mill, at Victor, Colo. was designed to treat not only ore from the Portland Gold Mining Company's property, but to operate as a custom mill for the low-grade ores of the Cripple Creek district. For this reason a very modern sampling department was incorporated in the design. The crude ore is crushed to maximum size of 1 inch, first in a Gates gyratory and then in a pair of Garfield rolls, and is then sent to the sampling department, which consists of four Vezin samplers, each making a one-fifth cut. The final cut is caught in a sample buggy, crushed to –4 mesh, and cut down to a 4-8 pound sample by means of a Jones splitter. A moisture sample of 5 pounds is taken from the reject and the balance held in the sample buggy until settlement. The moisture sample after drying and being weighed is returned to reject in buggy.

The sample is dried, and then put in a McCool pulverizer which takes the bulk down to –120 mesh. The material is then screened through 120 mesh, any oversize being bucked down by a King-Stanwood mechanical bucker. A 20 oz. sample is then taken from this material and poured into a Coard Mixer and Divider, which automatically divides the sample into four equal parts, which are then ready for assay.

The mill handles only low-grade ore, $4.00 per ton, and the operations are designed for the economical sampling of this material.

W. A. C.

Sources of Basic Refractories. By J. Spotts McDowell and Raymond Howl. (A. I. M. E. Bul., for February, 1919.)

The April 12th issue of the Engineering and Mining Journal contains a review of the paper on Sources of Basic Refractories, appearing in the February issue of the A. I. M. E. Bulletin.

Magnesite is the most important basic refractory. It is sold finely ground, in brick from, or in small grains. Dead-burned magnesite, partly sintered, does not hydrate on exposure to the atmospheric conditions. 4.5 to 6 per cent Fe_2O_3 seems necessary for proper sintering.

Prior to 1914, most of our supply, as well as the World's came from Austria-Hungary and Greece. The development of our domestic resources was brought about as a result of the War, and at present we have, adequately blocked out, sufficient ore to last many years.

Dolomite is also used as a refractory but hydrates on standing, even if exposed for only a short time. Special mixtures of dolomitic refractories have been devised to overcome this objection. These are usually made by mixing dolomite with iron ore or with basic open-hearth slag, and calcining the mixture at a high temperature (2800°F).

W. A. C.

Estimating Screen Efficiency. By W. O. Borcherat. (Eng. & Mining Journal, April 12, 1919.)

A detailed discussion of the methods for determining screen efficiency, together with a number of representative curves and their value to the mill man.

W. A. C.

Practical Considerations in Ammonia Leaching of Copper-Bearing Ores. By Lawrence Eddy. (Chem. & Met. Engineering, April 1, 1919.)

The Kennecott Copper Corporation, operating at Kennecott, Alaska, is successfully leaching copper ores with ammonia. The plant treats tailings from a wet concentrating plant, and has a capacity of 600 tons per 24 hours. The ore contains copper sulphides and copper carbonates. The gravity methods are used to recover the sulphide but the copper carbonate and limestone gangue, which have about the same specific gravities cannot be separated by jigging or tabling. The gangue of limestone would prohibit the use of acid for leaching and ammonia is used with success. The copper is recovered by heating the leaching solution, the copper precipitating as CuO. No gold, silver or copper (if in the form of a sulphide) can be recovered with this method.

The tails from the concentrating plant are first deslimed and then the sands dumped into leaching tanks, made of steel boiler plate, and the surface leveled off. The bottom of the tank is similar to those used in cyanide work. A steam wash is used to clean the leached ore. Small centrifugal pumps are found to be the best to handle the solution, as the air lift carries off quantities of ammonia with the exhaust air. Leaks in tanks are a source of considerable expense.

Cost of leaching, exclusive of mining, crushing, overhead expense, freight and smelting charges, tailings disposal and selling expense was about $0.85 per ton. The cost of the plant was low, about $300.00 per ton of daily capacity.

W. A. C.

The Problem of Treating Impure Manganese Ores. By Edmund Newton. Pamphlet 9—War Minerals Investigation Series, U. S. Bureau of Mines.

An abstract of this pamplet will be found in the Engineering and Mining Journal, of March 29th. The abstract deals with the common gangues and impurities found in manganese ores, their elimination and effect on the uses of manganese. W. A. C.

A Portable Precipitator. Lt. Col. Arthur B. Lamb. (Metallurgical and Chemical Journal, April 15, 1919.)

An air purifier which utilizes the principle of Cottrell precipitator has been devised and found to be very successful as a preventative against toxic poisoning.

The current is furnished by a lead storage battery of special form. The battery furnishes 30 watt-hour at ½ amp. for 10 hours. An induction coil of special form, having an output of 875 volts, with 16 micro amps is used in connection with the battery to furnish the necessary voltage.

As many tubes as are necessary for the volume of air required are used, connected in parallel. In its present form the precipitator uses four glass tubes of 1½ cm. dia., and 12 cm. long, each wrapped in copper gauze. The inner electrodes consist of fine copper wire connected to the outside electrodes and properly insulated from the outer electrode tubes.

A full size portable outfit was constructed and worn by a man in an atmosphere of diphenylchlorarsin smoke. Such an atmosphere was found to penetrate all but the very best filters within a few minutes, but the man wearing the electrical precipitator was able to remain a full hour without suffering any discomfort whatever.

It has been illustrated conclusively that 100% of the smoke or fumes present in any atmosphere can be precipitated if passed through the timber at a rate of not more than five litres a minute for each tube. A canister containing a gas mask is of course used between the precipitator and the wearer in order to remove toxic gas or vapors which might be present.

The weight of the preciptator as improvised was about 1 pound. When manufactured in quantity it would be only a few ounces. The tubes would probably be made from iron or aluminum instead of glass.

Electrolytic Silver and Gold Refining. By Mr. George G. Griswold. (Chemical and Metallurgical Engineering Journal, April 15, 1919.)

The silver to be refined is cast into anodes weighing about 100 ounces each. The cathodes are made of cold-rolled silver, 1-32-in. thick. The anodes are placed in kegs to catch the impurities as the silver is taken into solution. There are four bags and five cathodes in each tank. Each bag holds four anodes.

The silver is constantly brushed from the cathodes by wooden stocks, reciprocating moving. This device tends to prevent short-circuiting and also serves as a means for circulating the solution. The deposited silver drops into wooden boxes and is removed daily. After being removed it is washed in vacuum boxes and transferred to the melting room.

The electrolyte is a neutral nitrate solution containing from 15 to 20 grams of silver, and from 30 to 40 grams of copper per litre. Silver nitrate is added as required, and sufficient electrolyte is withdrawn daily to keep the purity up to standard. The waste electrolyte is put in wooden tanks and the silver is precipitated on copper. A current density of about 40 amp. per sq. ft. is used.

O. H. M.

Notes on Electrostatic Precipitation. By Mr. H. D. Braley. (Chemical and Metallurgical Engineering Journal, April 15, 1919.)

In a short article the author deals with the various applications of electrostatic precipitation for the recovery of metallic dust, of antimony, sulphur, arsenic and potash.

In the discussion it is pointed out that the kentron is very practical for the rectification of alternating current. The operating temperature of the filament is about that of an ordinary incandescent lamp—far below the melting point of tungsten. A control panel has been perfected by the General Electric Company which protects the kentrons against high voltage stresses.

Kentrons can be operated in parallel to obtain any quantity of power, whereas mercury arcs cannot. The kentrons can be operated up to 150,000 volts, and reduces to a minimum the surging of the precipitable circuit. Oscilligrams show a flattening effect on the high voltage waive of the circuit of the Cottrell precipitator when the kentron is used for rectification. When the mechanical rectifier was used the oscillograms showed a distorted voltage wave. O. H. M.

Extraction of Uranium from Pitchblende. By Dr. S. C. Lind, Bureau of Mines, Golden, Colo. (Chem. & Met. Eng. Journal, April 15, 1919.)

The extraction of uranium from pitchblende ores is done in five operations:

1. The powdered ore is roasted until all of the sulphur and arsenic is removed and the uranium changed to the sesquioxid.
2. The roasted material is mixed with carbon and put in an electric furnace with two hearths. Insufficient carbon is added to reduce all metallic oxides. The lead, copper, nickel and cobalt are liberated in the metallic state and are drawn off. The uranium, molybdenum, tungsten and vanadium form a slag of oxides and silicates.
3. More carbon is added and the uranium, molybdenum, tungsten and vanadium are reduced to carbides.
4. The carbides are pulverized and treated with water. Uranium carbide decomposes water, forming hydrated uranium oxide. This is separated from the other carbide by flotation.
5. The hydrated uranium oxide is treated by electrolytic methods for the recovery of metallic uranium and its compounds and alloys.

The mixture of carbides of tungsten, molybdenum and vanadium is treated by other methods for the tungsten, molybdenum and vanadium it contains.

O. H. M.

A Small Hydro Electric Installation. By E. P. Hollis, A. M. I. E. E., M. Amer. I. E. E. (From the Mining Magazine, March 19, 1919.)

The author gives an introductory discussion on the production of power from small waterfalls and mountain streamlets for use in various industries.

A number of springs on the property of the manufacturers are used as a source for filling a 6,000,000 gallon reservoir. The water is taken from the reservoir through a nine-inch pipe to the power house three-fourths of a mile away and 5 or 6 feet below the reservoir.

The generating plant consists of a tangential wheel of the Pelton type, direct connected to a 60 K. W. D. C. generator, 550 volts. The speed is controlled by a governor without rotating parts. In case of an accident, the water can be shut off in a fraction of a second without injuring the pipe line. The governing proper is done by deflectors. A spear is inserted into the end of the nozzle, making the amount of water used proportional to the power required. The entire unit is controlled by a remote control system at the mill where the power is used.

O. H. M.

GEOLOGY.

Nickel in South Africa. By T. G. Trevor. South African Journal of Industries. (Mining Review, March, 1919).

The most important nickel deposits in South Africa are those of the Insizwa range. The geology has been worked out by A. L. DuFoit, and W. H. Goodchild. The Insizwa range rises about 6,000 feet above sea level and 3,000 feet above the surrounding country. Consists of a norite-gabbro sheet from 1,000 to 3,000 feet thick. At the base of this gabbro there are shales which have been metamorphosed into hard-hornfels. The base of the gabbro dips inward in all directions from the margin, so that the lower surface of igneous rock forms a basin.

The nickel deposits occur at the contact of the gabbro and the underlying sedimentaries. The ore minerals are chiefly sulphides, the principal ore being pyrrhotite, chalcopyrite and pentlandite. The latter mineral is the one which bears the nickel. Nicollite and bornite have been observed. The gold-platinum group of metals also are found.

The rich sulphide bodies of ore occur at the contact and gradually grade into barren gabbro and norite farther up. It is thought by both men who described these deposits that they were formed by magmatic segregation, assisted by gravitation. This being the case, it is very probable that the richest and most extensive ore-bodies are near the center of the basin-shaped bottom of the igneous rock which has not yet been developed.

Copper and nickel seem to be present in almost equal amounts, ranging from 2 to 3% in the disseminated ores. Platinum is present to the extent of from 1-40 to 1-20-oz. per ton.

A Review of the Development in the New Central Texas Oil Fields During 1918. By W. G. Matteson. (Econ. Geol., March-April, 1919; Vol. XIV, No. 2, pp. 95-146.)

Following the bringing in of the McClesky well with an initial production of 1,200 barrels, near the town of Ranger, on October 25, 1917, there has been great activity in north central Texas resulting in the discovery of six additional fields of great promise, namely: Breckenridge, Caddo, Veale, Black Brother, Allen and Duke. Developments of the next few months are expected to result in the discovery of several new fields.

All the new fields developed to date show indications of surface structure but sub-surface structure may be much more pronounced because of the unconformity at the top of the Bend series. At least 70 per cent of the surface structures, drilled to date, have yielded oil or gas in commercial quantities.

"Favorable structural conditions for commercial accumulations of oil occur where cross-folding has been superimposed upon extensive flexures resulting from the uplift, which produced the Bend arch. The trend of the axes of the flexures are generally slightly northeast-southwest, while the direction of the axes of the cross-folds is nearly at right angles to the axes of the flexures."

There are eight producing oil horizons. Six of these belong to the Bend series, of Mississippian Age, of which five are in the "Black Lime" or Marble Falls limestone, the source of the most prolific production. The remaining two are in the overlying Strawn formation of Pennsylvanian Age.

The oil of the central Texas fields is of a high grade, ranging from 34 to 40 degrees Bé.

F. M. VAN TUYL.

Oil Possibilities of the Rio Virgin Anticline. By W. E. Calvert. (Salt Lake Mining Review, March 30, 1919.)

The area in question is in Washington County, near St. George, Utah, and about 100 miles from Cedar City by stage.

The geology of the district can be determined with certainty as all the formations for considerable depth outcrop and are open to inspection. On account of uplift and later erosion much of the Paleozoic and Mesozoic formations are exposed, and in the Grand Canyon, lower formations down to the crystalline Archean are open to study.

The youngest sediments exposed are Jurassic, represented by beds of salt, gypsum and white limestone, total thickness about 1,200 ft. Triassic rocks follow with 2,500 feet of sandstone, and at base of which is the Shinerump Conglomerate, forming cliffs where exposed, on account of its hardness. Permian beds are 2,000 feet thick followed by Kaibab limestone containing flint, chert, and silicious material. Under this is the Coconino sandstone, 350 feet of fine grained sands and is the lowest formation exposed in the immediate vicinity. Further study in the Grand Canyon shows the Coconino to be followed by the Supai sandstone, 400 feet of red shaly sandstone, 850 feet of fine sandstone, 100 feet of red shale and crystalline limestone. These with the Kaibab and Coconino are Carboniferous and comprise what is known as the Aubrey group of the Pennsylvanian. It is from this group that oil must come in this district.

Structural features are the Hurricane Fault, which cuts the Grand Canyon, extending north beyond Cedar City and exposing the Kaibab limestone in a cliff on the upthrown side, and a long fold known as the Rio Virgin Anticline forming what is known as the Harrisburg, Washington, and Bloomington domes, and oil if present will be confined to these domes.

Conditions for oil accumulation are five:

1. A source of oil.
2. Storage strata near the origin.
3. Structures favoring the accumulation.
4. Fairly complete saturation with water of underlying strata.
5. Reservoir must have an impervious cover to confine the oil.

Of these five the third is one which can be determined with certainty before drilling, the first may be ascertained in some cases by a study of the geologic section, as also may be the second.

Applying these conditions to this district a final conclusion cannot be reached, but a commercial pool seems remote. The Kaibab limestone is too silicious for a source and too permeable to be a reservoir. The Coconino is not a source and having shown no oil saturation its capacity as a reservoir is doubted. As regards the Supai, inference gives place to certainty owing to the inability to study this formation in any near exposures, but where exposed its character is such as not likely to be a source of oil.

The occurrence of oil in a well near Virgin City need not be taken seriously as this comes from earlier rocks than the Kaibab sandstone, being in basal Permian.

Conclusion is that oil may be found, but it is improbable; proof positive may be had only by test drilling.

Fred L. Serviss.

Oil Shales of the Great Unitah Basin, Utah. By Don Maguire. (Mining Review, April 15, 1919.)

The Unitah Basin, occupied by the Green River, was once a great lake Thousands of feet of sediments were laid on the bottom of it until it was almost filled. As climatic changes took place, the Southern barrier walls of the old lake were eroded. As the Green River cut its way down to the bottom of the ancient lake, all of the sedimentary strata were exposed to view.

For the most part the sediments are horizontal or nearly so, but in places the dip is nearly vertical, due to local dynamic forces. Domes and dome structures indicate the probability of a great many oil and gass pools in the Unitah basin. The sediments of which the Unitah mountains are made up are faulted and folded. On the fissures produced by this faulting and folding are found veins of gilsonite and asphaltum. These veins are plentiful. Some of them are 12 feet wide and very extensive in length and depth.

There are very extensive oil shale measures. The beds of oil-shale are from 1 to 125 feet thick. The shale runs from 15 to 54 gallons of oil and from 10 to 15 pounds of ammonium sulphate per ton.

It has been estimated that the oilshales of this district contain 42,800,000,000 barrels of crude shale oil and 500,000,000 tons of ammonium sulphate. There are very few minerals found in the district. A small copper property has been opened up near Vernal, but outside of this the mineral resources are insignificant.

Very little has been done for the development of the oil shale measures and the gilsonite and asphaltum deposits of this region. This is probably due to the lack of adequate transportation facilities. The St. Louis Gilsonite and Asphaltum Co. produce about 200 tons of gilsonite per week. It is shipped by means of mule teams to Price station on the Rio Grande Railway, 60 miles away. The gilsonite as handled, brings a net return of $60.00 per ton to the mine owners.

Gasoline From Natural Gas. By John D. Northrup. (Mining Review, April 15, 1919.)

The production of gasoline from natural gas is a branch of the natural gas industry, that has attained special importance.

The foundations for the industry were laid in 1903 and 1904 by Fasenbeyer. The research work in connection with the industry was extended during the period between the years of 1905 and 1908 by Richards.

The subsequent growth of the industry has been very great. In 1911, 176 plants in nine states produced 7,425,839 gallons of raw gasoline. Six years later 800 plants in twelve states produced 217,884,104 gallons, a gain of 403 per cent.

Prior to 1916 the greater portion of gasoline recovered from natural gas obtained from casing head gas, oil well gas, or "wet" natural gas, by methods involving compression and condensation. Since 1913 a steadily increasing proportion of the annual output has been recovered by the absorption process.

G. M. Sabolt, a chemical engineer of the Hope Natural Gas Company, is given credit for the development of this process. In addition to gasoline, liquid propane and butane are produced, in considerable quantity, by the absorption process.

O. H. METZGER.

CHEMISTRY.

The Determination of Manganese—A Modification of Volhard's Method. By W. C. Riddell. (Mining & Scientific Press, April 19, 1919.)

The April 10th number of the Mining & Scientific Press contains an interesting modification of the Volhard method for determining manganese. Using this method the end point is readily determined and the time of making the determination is considerably shortened.

W. A. C.

The Recovery of Salt from Sea Water. By F. H. Mason. (Mining & Scientific Press, April 19, 1919.)

At the Western. Salt Company's plant, eight miles from San Diego, on the Bay, is located a salt plant which recovers salt from sea-water. The climate is ideal, with a light rainfall, high temperatures and dry. winds free from excessive moisture. Sea water contains about 3½ per cent solids, largely as NaCl. The "salt gardens" cover about 600 acres and consist of shallow pools known as tide ponds, secondary ponds, lime ponds and crystallizing vats.

Water from the Bay enters the lowest pool by a gate opened and closed automatically by the tide. From this pool it is pumped to the highest pond and thereafter gravitates throughout the system. The carbonates of iron, lime and the sulphates of lime precipitate out first as the liquid evaporates. The operations are regulated largely by the specific gravity of the solutions. and as soon as the sulphates are precipitated out, the solution is run into another pool and the salt precipitated, leaving magnesia salts still in the bitter solution. This is run into another vat and these salts are left as a residue from the evaporation.

The crystallized salt is washed in a strong solution of brine, then clean water, and finally screened. It is then ready for market. The product runs 99.75 per cent NaCl.

Capacity of plant in normal times is 15,000 to 20,000 tons of salt per year.

W. A. C.

Preferential Catalysis in Purification of Hydrogen. By Prof. H. S. Taylor, of Princeton. (Metallurgical and Chemical Engineering Journal, April 15, 1919.)

It was desired to oxidize the CO, contained as an impurity in hydrogen, to CO_2. It was found that Ni oxidized both the CO and the hydrogen. $Fe_2 O_3$ was found to be selective and oxidized the CO only. The process was very slow with $Fe_2 O_3$ alone, but with a mixture of $Fe_2 O_3$, and $Cr_2 O_3$ the reaction was speeded up 700 times.

O. H. M.

Effecting and Controlling Crystallization of Ammonium Nitrate. By J. Esten Bolling. (Chemical and Metallurgical Engineering, April 19, 1919.)

As the liquor or solution of ammonium nitrate leaves the filter presses, it is at a temperature of not less than 64 degrees C. A slight cooling takes place at the dilution tanks, but this is not sufficient to effect crystallization. It was desired to pre-cool the solution before transferring it to the crystallizing pans.

The pre-cooling was done as follows: The solution was run through a 2-inch pipe within a 3-inch pipe. A metal spiral was wound around the 2-inch pipe to fill the annular space between it and the 3-inch pipe and also to increase the circulation and afford uniform cooling. This prevented the 2-inch pipe from sagging and touching the 3-inch pipe, as the pipes are both 20 feet long, the smaller diameter pipe could be expected to sag the most.

Thermostats are placed in the solution outlets from the pre-coolers, and so connected that the cooling water is instantly cut off whenever the temperature of the solution drops below the danger point.

Temperature control is one of the most important features. This is due to the narrow limits of temperature between the crystallization temperature of $NH_4 NO_3$, and the temperature at which other salts crystallize.

Dilution is also necessary in order to prevent supersaturation at the temperature desired for the crystallization of $NH_4 NO_3$.

In order to maintain the proper concentration which is carefully determined and effected at the dilution tank, and also to prevent excessive surface cooling, it is desirable to minimize evaporation as much as possible. This is done by keeping the vapor pressure of the air the same or slightly higher than that of the solution. This prevents evaporization, and also effects rapid and efficient cooling.

O. H. M.

DISCUSSION

COMPENSATION.

Golden, Colo., April 30, 1919.

Many men extend their moral and financial support to a worthy cause without expecting any reward beyond the satisfaction of knowing that they have rendered valuable service. Some men deny themselves a personal indulgence, or even sacrifice a personal convenience in order to contribute toward the success of a meritorious movement, the ultimate object of which is to serve. Action which benefits others instead of benefiting self is called altruism. It is the opposite of egoism. Altruism suggests unselfishness. Some men demand their money's worth, and they have a perfect right to expect it if they spend their money wisely. Many men get their money's worth in the form of satisfaction for having helped something succeed that is worth while. Patriotism is sometimes the motive behind certain expenditures. It is possible for one to be patriotic, altruistic, and get his money's worth all at the same time. The scheme may be explained something like this: It costs money to publish a magazine. A magazine derives its income from its subscribers and from its advertisers. The revenue from subscriptions is relatively small compared to the earnings of its advertising pages, but the longer the list of subscribers, the larger the circulation that can be guaranteed to the advertisers. The larger the circulation, the easier it is to get more advertisers and to charge more money for the space. The more numerous the advertisers, the greater the earnings. As the earnings increase, more money is available to pay for printing more pages for the benefit of the subscribers, and to pay for valuable articles which would otherwise find their way into other technical publications. As the amount of space devoted to first-class technical articles increases, the magazine will increase its power to serve, the circulation will increase, more advertisers will be amenable to argument, the market price of the advertising space will advance, and more money will get into the treasury for the ultimate benefit of the subscribers who will receive their dividends in the form of food for thought. Such a process is sometimes referred to as pyramiding. Eventually the publication will have a reasonable thickness, will demand and receive the respect of other and older magazines, will occupy a well-deserved place on the desk of many discriminating engineers and technical men, will be a credit to the Colorado School of Mines, an honor to its Alumni, and will inspire a feeling of extreme satisfaction in the minds of those early subscribers who gave it their unselfish financial and moral support at a time when it needed their help. Do you grasp the idea?

Respectfully yours,
HARRY J. WOLF, '03.

Cleveland, Ohio, April 21, 1919.

To Members War Service Committees, Business Executives, and Editors.

Gentlemen:

If the value of things people buy were established in the minds of the people would there be the hesitancy in business we are now facing?

The individual producer is the one to say what price he must receive for his wares. His business judgment will not permit him to ask an excessive profit (that would invite competition and perhaps excess production with destructive results), and he certainly dares not quote prices which cannot return proper compensation to the capital and labor invested in his product.

Satisfactory sales are based on confidence between the buyer and seller.

It is our belief that prices made effective for specified periods or seasons will establish confidence in prices.

We are therefore telling our buying public what our prices are and that there will be no change for definite periods. To make the plan effective, we have deemed it advisable to make price periods of not less than six months.

If every producer who is not already doing so will adopt this plan, making his prices known to the public by advertising as well as by individual quotation, we believe that confidence will be restored and that the present enormous potential demand will be brought into action. Perhaps the best examples of this PUBLISHED, OPEN-PRICE PLAN ARE:

1. The retail drygoods business of the country whose prices are known to every individual through publication in advertisements and through tags on the goods in the stores.

2. The automobile industry which once every season names its price to the public for that season so that every individual, possible customer or not, is made familiar with the value of the article.

These two industries are perhaps the only two large industries whose business has been and is now active since the Armistice.

If the manufacturers of cement, of steel, producers of lumber and other building materials, manufacturers of clothing, food products and machinery, had followed this PUBLISHED-PRICE-FOR-THE-SEASON method and the prices of these commodities were established in the minds of the public, there would not now be the marked halting in business.

If you agree with this reasoning, will you not reply to this letter saying that you will assist by every means at your command to induce your company, your industry, other businesses and industries to help stabilize business promptly by adopting a plan of action over this slogan—PRICES EFFECTIVE FOR SPECIFIED PERIODS OR SEASONS WILL ESTABLISH CONFIDENCE BETWEEN BUYERS AND SELLERS.

Yours very truly,
LAKEWOOD ENGINEERING CO.
ROY G. OWENS,
General Sales Manager.

The insertion of a Colorado School of Mines card in the "Stars and Stripes," the official organ of the A. E. F. in Europe, has brought many inquiries from the prospective returned-soldier-students. The school is offering special concessions in the way of fees remitted to honorably discharged members of the various branches of the U. S. Military Service.

The coming Football season gives promise of adding a new meaning to the famous expression, "The Old Mines Spirit". The athletes who will comprise this year's team, will be chosen from the ranks of the returned soldiers. These men have had military training supplemented by the gruelling test of battle. At the Marne, Chateau Thierry, Bellau Wood and the Valley of the Rhine their every faculty, physical, mental and spiritual, was put to a supreme test. This season's football games should therefore have in them that element of indomitable purpose that knows no other result but victory or death.

Colorado School of Mines Magazine

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COMMENCEMENT DANCE.

At the "eleventh hour" the Junior class made the announcement that they would be unable to give the annual Junior Prom. Instead there will be an informal "Commencement Dance" on Friday, May 23rd. This will be given by the student-body and the faculty. All the alumni of the school and their friends are invited. Come in the afternoon and attend the graduation exercises and stay over for the dance. Refreshments and a luncheon will be served. Make a special effort to attend and help make this a grand reunion. Mr. Edwin S. Church, president of the Wellman, Seaver, Morgan Co., of Cleveland, Ohio, will deliver the Commencement Address.

AN ENIGMA.

Why is it that with a 25% less labor-supply, and with this, 25% less efficient, we were able to increase our domestic mineral production during the war period? The reason is that all effort was concentrated on production. Development, new construction and proper maintenance were temporarily neglected.

NEW DIRECTORY OF ALUMNI EX-MINES MEN.

Because so many of our subscribers are outsiders, it has been deemed advisable to publish the Directory of Addresses, and occupations, of all the Alumni and Ex-Mines men, in a notebook form, and not devote a special number of the Magazine to it, as has been previously done.

The booklet will be 3¾ by 6¾ inches in size, of loose-leaf form, suitable to be carried in the pocket or inserted in a note-book.

If you wish a copy kindly tear off the attached slip, and enclose 35 cents in currency or postage. This barely covers the cost of printing.

The Directory will be issued about July 1st. Only a limited number will be printed, therefore if you wish a copy send your remittance promptly.

ATHLETIC ASSOCIATION BANQUET.

On Friday evening, April 11th the "M" (letter-men) club held its first annual meeting at the Albany Hotel. The occasion of the banquet was to present the sweaters to the members of the various teams. Unfortunately, the date was not decided upon in time to announce it in the columns of the Magazine. Nevertheless the banquet proved to be the most successful and well-attended one ever held. Practically every student and faculty member in school attended and a large percentage of the local Alumni members.

Dinner was served at 7:30, and during the courses vaudeville singing and dancing acts furnished entertainment for the guests. After the meal, Dr. Victor Ziegler, chairman of the Athletic Board, was introduced by Mr. Henry G. Schneider, '17, the chairman of the committee in charge of the Banquet.

In presenting the sweaters, Professor Ziegler said: "In accepting these sweaters these men take upon themselves new duties. While they have these sweaters, they must see that they continue in their loyalty to the school and see that the ideals for which the Mines spirit stands are upheld."

Sweaters bearing the football "M" and gold footballs were then presented to all the men who made their letter in football last fall. These were Chester M. Pitser, Captain of the championship team; Jules C. Benbow, Edward Gibbons, Ronald Coulter, Rene Mechin, Joe Haskins, Sidney Morton, "Dad" Mulford, Ernest Bunte, Nicholas Galluci, George Dunn, Arthur Bunte, Paul Wright, Gus Epeneter, Thomas Fahey, and P. F. Brown. Other members of the team who had not made their letter but were given gold footballs were: Hale Strock, George Hyland, and G. A. Son.

Sweaters were then awarded to the 1918 baseball team. These were: Gus Neumann, "Stew" Henderson, A. Frenzell, Guy Miller, Hale Strock, Andrew Robb, Donald Bailey and Otto Metzger.

The 1918-1919 basketball sweaters were awarded to Addison Garnett, Louis Bryan, "Dusty" Rhodes, and Fred Lichtenfeld, the manager.

PERSONALS

'92.

N. H. Brown has returned to Idaho Springs, where he has taken over the engineering business of W. A. Funk, '03.

'95.

Captain Charles T. Durell's address is: Camp Headquarters, Camp Humphreys, Va.

George A. Kennedy is with W. C. Laughlin Co. at La Colorado, Sonora, Mexico.

'96.

G. B. Mitchell has been transferred to Port Huron, Michigan, where he is General Superintendent for The Foundation Co., Port Huron Shipyard, Inc.

'97.

Louis Cohen has removed his offices from the Ideal Bldg. to 509 Quincy Bldg., Denver, Colo.

H. B. Starbird is now with the Silver King of Arizona Mining Co., at Superior, Arizona.

'98.

James A. Ingols is now at 222 O. S. L. Depot, Salt Lake City, Utah.

'01.

Our members will be glad to read the following abstract of a recent letter from James L. Bruce, General Manager of the Butte & Superior Mining Co.:

"I have just recently returned to Butte from a somewhat lengthy trip, upon which I visited Denver, Joplin, the Oklahoma Zinc Mining District, St. Louis, New York and Washington, and during which I had the pleasure of visiting with quite a few of the Alumni whom I had not seen for several years.

"In the northeastern corner of the wonderful State of Oklahoma there has sprung up, within the past three or four years, a truly remarkable mining activity. On what was a few years ago almost a prairie, there is today, what may be likened on a huge scale, a thickly populated gopher colony; with men and machinery, burrowing into the earth, and piling up numberless heaps of the excavated material in the form of tailings dumps. From any of the higher head-frames of the centrally located shafts, within a radius of two miles, the observer can count close to 100 concentrating mills, each with at least one dump of tailings and a settling pond. Automobiles, trucks, street cars, trains, teams and individuals scurry about from one point to another, and this is, in fact, more of a frontier town in appearance than almost any of our Western mining camps.

"It is estimated that within the last five years there has been expanded within this small area, no less than $35,000,000.00 for drilling, exploration, mine development and construction of mills. This amount includes the cost of at least six or seven million feet of churn drill-holes.

"This mining development, although apparently crude in many phases, is, as a matter of fact, a highly efficient operation. No better economic experience could be gained than by studying the mining business as it is there conducted.

"After leaving the Joplin District, I was fortunate in reaching St. Louis in time to attend the annual banquet of the American Institute of Mining Engineers. I renewed my friendship with Charles Adami, who is manager of the extensive operations of the St. Joe Lead Company at Bonne Terre, Mo., and elsewhere; with Howard G. Washburn, manager of the Federal Lead Company at Flat River; with "Lafe" G. Johnson, Buehler, Thompson, Coleman and many other Mines men of that district. President Winchell, Ex-President Moore, and Secretary Stoughton added to the life and entertainment of the meeting.

"In New York it was my pleasure to witness and take part in the enthusiasm and welcome accorded the 27th Engineers.

"In Washington I had many pleasant visits with officials of the American Mining Congress and of the Bureau of Mines. My visit there was for the purpose of preparing for presentation before the United States Supreme Court the argument of the flotation-litigation between the Butte & Superior Mining Company and the Mineral Separation North American Syndicate, Ltd."

M. C. Scheble is now Manager of Cia de Combustibles "Agujita" S. A., Sabinas, Coahuila, Mexico.

'03.

Walter A. Funk left for Colombia, South America, the latter part of March. Funk was recently discharged from Y. M. C. A. Transport Service.

'05.

Homer D. Ford, superintendent of the Gilson Asphaltum Co. of Watson, Utah, was in Denver recently.

L. B. Eames has returned to his home, 3009 High Street, Pueblo, Colo., after an absence of two years. Eames has been to South Africa for the Dorr Company. He sailed from San Francisco and visited in Australia en route. On his return he spent several weeks in England. He virtually encircled the globe.

'06.

J. B. Brown has been transferred from the London office of the Allis-Chalmers Mfg. Co. to their Chicago office, in the Peoples Gas Building.

'07.

A. C. Norton was at his home in Denver, on a short visit recently. He is at present working on the construction of a large dam near Baldy, N. Mex., for which he has a contract.

'08.

Jesse T. Boyd is with the New Jersey Zinc Co. at their New York office, 160 Front Street.

'09.

C. B. Hull and Miss Ella M. Carmichael, of Butte, were married on Dec. 19 last. Mr. and Mrs. Hull are at home to their friends at 406 Virginia Apts., Butte, Mont. Hull is now manager of the Crystal Copper Co.

W. G. Channing has been chosen from his company in the 27th Engineers to take a few courses in mining at the University of Birmingham, England.

Lt. E. J. Ristedt is now in the office of the Chief of Engineers of the War Department, Washington, D. C.

'10.

Charles Dyer and family are visiting at his home in Golden.

Lt. J. J. Whitehurst was a visitor in Golden recently. He saw seven months' service overseas with the 315th Artillery.

R. P. Fitzgerald has returned to his home at Roswell, N. Mex. Fitzgerald saw several months' service overseas with the 27th Engineers.

'11.

Lt. Frank W. Lee has returned from France. He is at his home address, 3447 Bryant Street, Denver, Colo., on a short visit.

S. R. Brown was discharged from the 27th Engineers at Fort Russell recently. He is at Montrose, Colo., on a short holiday.

Karl V. Geib is now at Box 1726, Telluride, Colo.

'12.

E. S. Geary is sales manager of the Pump and Compressor Department of the Denver office of the Mines & Smelter Supply Co.

Wm. G. Ramlow has left the Empire Zinc Co., at Gilman, Colo., and is a construction engineer at 475 W. Central Ave., St. Paul, Minn.

Verne Frazee has returned from the Orient, and is now at his home address, Moweaqua, Ill.

D. L. Beck is convalescing at his home, 352 Elati Street, Denver, from a severe attack of double pneumonia, followed by empyema, which he contracted at London, Ontario, while in the military service. He has been ill for several months.

Leon M. Banks is taking a few months' course in mining at the University of Birmingham, England, at the government's expense. He will receive his discharge from the service upon the completion of his course.

'13.

Harold C. Price has been transferred to the American Zinc & Chemical Co. at Longcloth, Pa., from the New York office of the American Metal Co.

W. D. Peregrine has recently been discharged from the 27th Engineers at Fort Russell. He is spending a short vacation at his permanent address, 200 S. Emerson Street, Denver.

W. J. Eaton has been transferred to care Minerales y Metales, S. A., Apt. 158 Saltillo, Coahuila, Mexico.

Daniel B. Gregg is engaged in experimental flotation work at the Sunnyside Mill, Eureka, Colo.

T. M. Stephens is at his permanent address, 777 S. Williams Street, Denver, Colo. He recently returned from Arden, Nev., where he was superintendent of the Empire Zinc Co.'s Potosi Mine.

'14.

Rufus E. Litchfield has returned to his home, 14 Arlington St., Fitchburg, Mont., from France. He was with the 29th Engineers.

'15.

Lt. Dan W. Butner has recently been discharged from the 27th Engineers. He is on a short holiday at his home at 812 E. Cache la Poudre Street, Colorado Springs, Colo.

John N. Teets is now engineer with the Akron Mines Co. at Whitepine, Colo. Teets was recently discharged from the naval aviation.

L. A. Stewart is with the Fairview Fluorspar & Lead Co. at Golconda, Ill. Stewart returned recently from the Philippine Islands.

Wm. Simon has received his discharge from the navy and is on a short holiday to his home at Florence, Colo. Simon was a wireless operator on U. S. Mine Sweeper Ontario. He was married last June to Miss Lela Moore of Wilson, N. C. He expects to return to his old position at Superior, Ariz.

'16.

R. M. "Steve" Fullaway has been discharged from the service and is now with the Ray Consolidated Copper Co. at Ray, Ariz.

Frank A. Smith has been recently discharged from the service, and is temporarily at his permanent address, 217 10th Street, San Pedro, Calif.

Lt. Jay J. Burns has returned from overseas, and is back at his old position with the Butte & Superior Mining Co., Butte, Mont.

Chas. R. Vorck is with the 115th Engineers attached to 9th Army Corps of the Army of Occupation, located near Saint Mihiel, France.

Richard M. Fullaway has returned from France and is with the Ray Cons. Copper Co., Ray, Ariz.

Wm. M. Travers has returned to his home at Central City, Nebraska. He saw overseas service with the 27th Engineers.

Capt. K. S. Ferguson is now at Delcarbon, Colo., care of Turner Mine.

'17 HON.

W. G. Swart has recently been elected president of the Duluth Engineers' Club.

'18.

Lt. Thos. H. Allan, of the Engineering Department attached to the air service, has returned to his home in Denver, after seven months' overseas service.

EX-MINES NOTES.

'09.

Thos. M. Skinner is now living in Denver at 62 Lincoln Street.

'10.

Earl A. Zeisloft is now City Engineer of Akron, Ohio.

'14.

Simon T. Weller is back from France, where he was in the Intelligence Department. His address is 1348 Logan Street, Denver, Colo.

'18.

Lt. John G. Menke has returned to Golden after ten months' continuous service at the front. He was with the 305th Engineers of the 80th Division.

OBITUARY.

'12.

Mr. Guy W. Erickson died of the influenza at Ouray, Colo., recently.

During the year 1918, Minas de Matahambre, Prov. Pinar del Rio, Cuba, produced 25,000,000 pounds of copper and 100,000 ounces of silver. There are at present three Mines men on the staff, namely D. Ford McCormick as Engineer in Charge; John V. Harvey, as Mine Superintendent, and Sidney W. French, as Mill Superintendent. This young copper mine has produced over 75,000,000 pounds copper to date, and has ore reserves blocked for 5 years at present capacity. It has been developed during the war, and built up under numerous difficulties incidental to shortage of labor and lack of materials. Until the concentrator started operations late in 1918, only high-grade ores were shipped to the U. S. A. by boat to be smelted.

School Notes

On April 24th the Board of Trustees met and selected the following faculty members for the year 1919-1920:

Reappointments: Clayton W. Botkin, Associate Professor of Chemistry; Regis Chauvenet, President Emeritus, Special Lecturer in Metallurgy and Mineralogy; H. M. Cronin, Analytical Chemist, Experimental Plant; Joseph S. Jaffa, Professor of Mining Law; S. Z. Krumm, Instructor in Mining and Metallurgy; J. L. Morse, Professor of Mechanical Engineering; I. A. Palmer, Professor of Metallurgy; J. C. Roberts, Professor of Coal Mining and Safety Engineering; L. D. Roberts, Assistant Professor of Chemistry; H. G. Schneider, Instructor in Geology and Mineralogy; James F. Seiler, Assistant Professor of Civil Engineering and Mathematics; F. M. Van Tuyl, Professor of Geology and Mineralogy; T. O. Walton, Professor of Mathematics; J. C. Williams, Assistant Director and Metallurgist, Experimental Plant; H. J. Wolf, Professor of Mining.

The resignations of Professor Victor Ziegler, head of the Geology Department; Prof. T. E. E. Germann, of the Physical Department; and Prof. J. W. Gray, of the Electrical Engineering Department were accepted.

The new faculty members are:

A. E. Bellis, Professor of Physics. Prof. Bellis is a graduate of the University of Michigan. He has been head of the physics department of the University of Wyoming since 1908.

A. P. Little, Professor of Electrical Engineering. He is a graduate of the University of Vermont, 1901, E.E. '05, and is at present teaching at Yale University.

R. M. Keeney, Director of Experimental Plant. Mr. Keeney is a graduate of the Colorado School of Mines, E. Met. '10. He has been an electro-metallurgist for the U. S. Bureau of Mines; Asst. Manager of the Baker Mines Co., of Cornucopia, Oregon; General Manager of the Iron Mountain Alloy Co.; and Consulting Metallurgist for the Anaconda Copper Co. He is at present a consulting engineer for the Westinghouse Electric Co.

Joseph F. O'Byrne, of the Colorado School of Mines, '05, will be Professor of Descriptive Geometry and Mechanical Drawing.

On April 4th the Theta Tau Society (Hammer and Tongs Club) gave an informal dance.

On Friday, April the 25th the class of '22 gave its annual Freshmen Ball. This function is usually scheduled to take place early in December, but this year because of the Military Training it was not possible to hold it then.

The School of Mines Commencement Day will be May 23rd. Thirteen students will receive their diplomas. This number is smaller than usual because several of this year's class are still in the Military Service.

JUNIOR NOTES.

Since the public last heard from the Junior class we have taken two more inspection trips. One was to Denver, where we visited the Globe Smelter in the morning, and the Western Chemical Company in the afternoon. At the chemical works the various manufacturers explained to us in detail by Mr. L. B. Skinner, president of the company. After going through the acid plant the class was taken to the electrolytic zinc plant. Here Mr. Skinner explained very fully the method used in treating zinc ores electrolytically. This plant is one of the very few plants in the West where this process is used. The class thanks Mr. Skinner very much for explaining to them this method of zinc treatment which gives promise of replacing, in the near future, the old-fashioned distillation process.

The other trip was taken under the tender care of our friend "Safety First Roberts." The class went to Leyden in automobiles. After going through the mine the class returned to the surface to study the hoist, tipple, screening methods, safety apparatus and precautions, first aid facilities, fans, and living conditions. Had it not been for the Sophomores it might have been a very enjoyable trip.

Three more of the junior class have been admitted to Tau Beta Pi. Ernest Bunte, Roy Sisson and W. B. Case were initiated last week. Their initiation work consisted of statistical curves on gold and silver which appears elsewhere in this issue.

As this is the last issue to be published while the present senior class is with us, it is entirely fitting that a word of farewell be said. We hate to see them leave us. When we were freshmen they rubbed us; when we were sophomores they attempted to convince us that we were worth our name sophomore—wise-fool; while they were seniors they have deeply impressed us with their dignity, and we know now, better than ever before, that the class of 1919 is a good bunch, and we wish them happiness and prosperity.

SOPHOMORE CLASS NOTES.

Our class wishes to congratulate the Frosh on the fine dance which they gave on April 25th. A large number of sophomores were present and all had a good time.

We are already looking forward to another twelve-hour shift on Prof. Wolf's Mine Surveying Final. Practically every one has arranged to have his three meals and, if necessary, his bed, brought over to Stratton Hall.

At a class meeting April 30, the following men were nominated for the several assistant manager jobs for next year. For Football Manager, Sunflush, Prentiss and Thomsen; Basketball, Edgeworth, Kay and Ireland; Track, Seeman, Marx, Deford; Baseball, Rolf, Baldwin and Fopeano. Elections will be held during the first week in May.

WHERE ARE THESE MEN?

Walter I. Spencer, '04.
E. F. Stoeckley, '05.
Herbert E. Badger, '02.
W. R. Brown, '10.
A. K. Gilbert, '06.
Paul H. Carpenter, '10.
Adolph Bregman, '14.
John H. Winchell Jr., '17.
Merritt Hutton, '14.
Frank A. Downes, '13.
C. L. Brown, '08.
Henry P. Nagel Jr., '04.
P. C. Yuan, '17.
P. M. Collins, '93.
Herman Dauth, '13.
T. L. Pittman, '14.
W. C. Hudson, '13.
C. L. Brown, '08.
W. H. Nance, '96.
L. C. Farnam, '09.
James L. Libby, '06.
Chas. N. Stephens, '98.
Sidney B. Tyler, '99.
F. M. Drescher, '00.
Forrest S. Dunlevy, '08.
Lester C. Thomas, '12.
Lynn C. Farnam, '09.
Col. L. R. Ball, '00.
Herman A. Kruger, '09.
P. H. Bertschy, '98.
Henry H. Forbes, '13.
Lieut. Irwin R. Solomon, '13.
Charles R. Hill, '12.

Athletics

W. B. Case, Athletic Editor.

Since the last issue, the Mines have played off almost their entire baseball schedule. At present they are leading the conference with four victories and one defeat. Besides the conference games, two games have been played with the Colorado Teachers College at Greeley, one of which resulted in a tie, and the other was easily won by the Golden squad. Boulder, the only team running in competition with us has also lost but one game, but has three games yet to play. In case they win these and the Mines defeat D. U., which is more than likely, the two teams will be tied for the championship. It is difficult to tell what will be done in such a case because the Mines finish their scholastic year on May 23, but the other colleges do not close until late in June. It is hoped, however, that some arrangement can be made to play off the tie.

Mines 6, Colorado College 2.

The conference opened April 13 with the Mines-Colorado College game at Golden. It was an easy victory for the home team. Our men had the game their own way throughout, and scored in three innings, but allowed the boys from Little Lunnon to score in but one inning. The feature of the game was the pitching. Regardless of the earliness of the season, both pitchers did excellent work. Pittser struck out eight tigers, walked none, allowed eight hits, and succeeded in hitting one. Hughes, who was pitching for the Tigers, struck out four, walked one, and allowed ten hits. Hughes was, however, poorly supported. The team work of the Mines was far superior to that of the visitors.

The first four innings were rather dull and neither team was able to score. In the fifth Dunn opened with a single. Miller bunted him to second, and was safe himself on first. Frenzell hit and scored Dunn and Miller. He then stole second and third, and was knocked in by Neumann's sacrifice fly to center. In the sixth Schneider walked. Henderson hit, advancing him to second, and hits by Miller and Frenzell scored both men.

In the eighth inning, Dunn, the smallest player on the team, got the home run which brought the fans to their feet. It was the only one which has been made this season.

The Tigers scored in the seventh. With two outs and Mr. Coal on second, Lawton singled, scoring Mr. Coal, and then went to second. Briggs hit, scored Lawton. This temporary streak of good playing saved the visitors from being whitewashed.

Score by innings:

										R.	H.	E.
Tigers	0	0	0	0	0	0	2	0	0	2	8	7
Mines	0	0	0	0	3	2	0	1	0	6	10	1

Batteries: Tigers—Hughes and Cover. Mines—Pittser and Neumann.

Umpire—Harper.

Mines 6, Greeley 6.

The next game was played in Golden on April 15, with the Colorado Teachers' College. The game was a tie and was called at the end of the ninth on account of darkness. The features of the game were the work of Frenzell, the Mines first baseman, who made two outs unassisted; two remarkable catches made by Miller in center field, and the pitching of Sullivan, the Greeley pitcher, not to speak of the wonderful work of "Skinny" Richards, who umpired the game. At the end of the eighth inning the score was tied. In the first of the ninth the Teachers got a man across for what seamed to be the winning score, but in the Mines' half, Sullivan made a wild pitch, on which Bunte scored, tying the game.

Sullivan allowed nine hits, walked six, and struck out eleven. Henderson, who pitched part of the game for the home team, allowed three hits, walked two, and struck out four. Krause, who finished the game, allowed four hits, walked two, and struck out three.

The score by innings:

										R.	H.	E.
Teachers	1	1	2	0	0	0	0	1	1	6	7	6
Mines	0	0	0	3	0	0	2	0	1	6	9	8

Batteries: Greeley—Sullivan and McPherson. Mines — Henderson, Krause, Neumann and Bunte.

University of Colorado 5, Mines 4.

The only defeat of the season was met at the hands of Boulder on April 18. It was simply a case of hard luck all around on strange grounds. The University men cinched the game by sending three runs across the plate in the eighth inning. The Miners scored two in the third. Henderson hit and scored on Dunn's three-bagger. Dunn then scored on Surfluh's hit. The University made one run in their half, Williams bringing in the tally.

Again in the fifth, Henderson and Miller scored for Mines and Willard for the University. Then in the eighth, with nine horseshoes in nine pockets the University scored three. It was a swatfest, helped along by errors made by the Mines players.

More or less has been said about the

fairness of this game which will not be printed here. Let us remember that the Mines are a bunch of sports and that they do not crab. We showed them how we can lose that day, but a few days later we showed them how we can win, and if we meet them to play off a tie we shall again give them a demonstration of the latter.

Score by innings:

		R.	H.	E.
Mines	0 0 2 0 2 0 0 0 0	4	4	6
Colorado U.	0 0 1 0 1 0 0 3 *	5	5	5

Batteries: C. U.—Willard, Breckenridge and Savage. Mines—Pittser and Neumann.

Mines 5, D. U. 3.

Denver University proved an easy victim for the Mines on April 23. Let it be said here that Denver University's present place in the league standing should be a warning to all other colleges not to follow D. U.'s method of supporting her teams. More Mines went to the trouble of getting excused from their afternoon classes and going twenty miles to support their team than there were D. U. students who had to walk but two blocks to the grounds, notwithstanding the difference in the attendance at the two institutions.

It was in this game that Chuck Schneider developed a craving for stealing home. He made it once, but was put out on the other trial. But who could blame Chuck for wanting to leave third base when you stop to think that Corfman, who was a lieutenant in the S. A. T. C. at Mines, was playing third base for the Ministers.

Krause, the "Southern Colonel," pitched for the Mines, and regardless of the fact that it was his first conference game, he handled the mound work well, was steady, and had the Ministers under his control at all times.

McKenzie, the D. U. pitcher, was badly hit throughout, and was poorly supported.

The eighth inning was a regular batting tournament for the Mines. Neumann singled and stole second after two outs had been made. Strock singled and scored Neumann. Schneider hit and scored Strock. Schneider then stole second and third. Not liking the atmosphere at third base, he stole home and brought in the third run of the inning.

Score by innings:

		R.	H.	E.
Mines	0 0 0 0 1 0 0 3 1	5	4	5
D. U.	0 0 1 0 0 0 1 0 1	3	7	2

Batteries: Mines—Krause and Neumann. D. U.—McKenzie and Liggett.

Umpire—Harper.

Mines 3, Colorado University 0.

The only shut-out game of the season was played between Mines and Boulder at Golden, April 26. The score alone is enough to indicate that it was a wonderful game. To quote Dutch Harper, the umpire, "it was the best game played in the conference this year."

Pittser was in his prime. He struck out nine and allowed but four hits. He had the Boulder team under his hand throughout the entire game, while his team-mates backed him solidly at all times. Time and again the visitors got men on the bases and on each and every occasion Pittser tightened up and refused to allow a man to cross the plate.

Schepferman started on the mound for Boulder, but was knocked out of the box in the seventh inning.

It was in the seventh inning that the Mines made their scores. Frenzell went to first and was sacrificed on to second by Dunn. Miller made a long, clean hit to center field, and scored Frenzell. Schneider flied out. Henderson hit for two bases and scored Miller. Henderson went to third on an overthrow at second. Neumann hit and Henderson scored. At this stage of the game Schepferman yelled to his coach "Take me out," which the latter promptly did, sending in Breckenridge to take his place. Strock hit the first one offered to him and was safe, but Neumann was out on an overslide at third.

Score by innings:

		R.	H.	E.
Boulder	0 0 0 0 0 0 0 0 0	0	4	5
Mines	0 0 0 0 0 3 0 0 *	3	4	6

Mines 8, Colorado College 5.

The Mines practically clinched the title on May 3 by defeating Colorado College in a 12-inning game by a score of 8 to 5. The Tigers took the lead in the first six innings and held it until the ninth, when the Mines put over three. Then in the last half, with two out, Neumann dropped the ball on the third strike. Another hit and two errors allowed the Tigers to score two, tying the score. The tenth and eleventh were scoreless for both teams, but in the twelfth the Mines gathered four hits from which they made three runs, and then held their opponents scoreless during the last half.

The score by innings:

		R.	H.	E.
Mines.	0 0 0 0 0 1 1 0 3 0 0 3	8	14	1
C. C.	0 0 2 0 1 0 0 0 2 0 0 0	5	4	4

Batteries: Mines—Pittser and Neumann. C. C.—Hughes, Hollister and Cover.

Mines 6, Teachers 0.

The Mines again defeated the Teachers on May 9 by a score of 6 to 0. On account of lack of space the details cannot be given. The game proved, however, that ours is the winning team. We have but one game yet to play, and that is with D. U. D. U. has not won a game this season and we are not going to break their record.

For the benefit of those who have not followed the conference baseball this spring, the following is inserted.

Mines' games:
- Mines 6, Colorado College 2.
- Minės 4, Boulder 5.
- Mines 5, Denver University 3.
- Mines 3, Boulder 0.
- Mines 8, Colorado College 5.

Boulder's games:
- Boulder 9, Denver University 5.
- Boulder 5, Mines 4.
- Boulder 0, Mines 3.

Colorado College's games:
- Colorado College 2, Mines 6.
- Colorado College 5, Mines 8.
- Colorado College 5, Denver Univ., 4

Denver University's games:
- Denver University 3, Mines 5.
- Denver University 5, Boulder 9.
- Denver University 4, Colo. College 5.

League Standing:

	Won	Lost	Percent
Mines	4	1	800
Boulder	2	1	667
C. C.	1	2	333
D. U.	0	3	000

INTRAMURAL BASEBALL.

Never in the history of the college has baseball taken such a hold on the students as it has this spring. Six teams have been formed. Each of the fraternities have one; the non-fraternity men have a team which they call the All-Stars; the foreign students from South America and the Philippine Islands have a team completing the six.

All games are played on the campus and are six innings long. The champions are to play the faculty during examination week. So far the players have succeeded in breaking two windows in Prexy's residence, one in Stratton Hall, and one in the Assay Laboratory. We wish them further luck.

A pennant bearing the words "Intramural, 1919," will be awarded to the winning team.

The games are well attended. The ability shown by the players is really amazing, considering the time they have been playing. It is planned to develop talent in this way for use on the college team next year. The league standing to date is as follows:

	Won	Lost	Percent
Beta	4	0	1,000
Sigma Nu ...	2	0	1,000
Kappa Sig....	2	1	666
All Stars	2	2	500
S. A. E......	0	3	000
S. Americans.	0	4	000

Much of the success of our baseball team has been due to our new coach, Bert Jones, better known to baseball fans as "Broncho" Jones, who took complete charge of the team early in the season.

Jones was famous as "Broncho" Jones with the St. Louis and Cleveland teams of the American League many years ago. He was a southpaw, with great speed and was one of the first players to use a curved ball. He later pitched for the Denver Bears.

Jones was engaged that Dr. L. C. Packard might take over the track team. He has put out a winner and we all thank him for the excellent work he has performed.

TRACK.

Our prospects for track are rather slim this year, yet Dr. Packard, who has charge of the men, seems hopeful. Pittser, Coulter, Marvin, Ireland, La Follette, and Rabb, all seem likely contestants. The State Intercollegiate Meet will be held in Denver at Union Park May 31st.

BOXING AND WRESTLING.

Boxing and wrestling have for the first time been admitted into college athletics on a par with other sports. The idea originated with the Mines who, through their athletic representative, suggested it to the conference. The suggestion was found to be a good one, and meets were arranged.

The first tourney was held in Golden between Mines and the University of Colorado. Mines won the meet by a score of 19 to 4. A large crowd attended and showed an interest and appreciation that seemed to indicate that boxing and wrestling will attain the same popularity as other sports. In awarding points, 5 were given for knockout, foul or default, 3 for a decision, and 2 to each side for a draw. Grover Coors was the referee. The boxing matches were for three two-minute rounds; the wrestling for one ten-minute round.

The results follow:

Wrestling, 165 pounds: Story of Mines threw Post of University easily in a little over one minute.

Boxing, 145 pounds: Strock of Mines won in second round from Everingin, the latter's seconds throwing in the sponge to prevent further punishment.

Wrestling, 140 pounds: Terrazas of Mines and Velser of University drew after an extra five minutes.

Wrestling, 158 pounds: Terry of Mines and Fulghum of University drew; Fulghum outweighed Terry by at least ten pounds, and laid down on the mat, refused to show any life, and left all the work to Terry, who was too light to throw him.

Boxing — Heavyweight: Gibbons of Mines won from Starks of University, when the latter's seconds took him out at the end of the first round to prevent further punishment.

Wrestling, 130 pounds: Lovelace of University and Kay of Mines drew. This was the fastest bout of the evening. Kay was badly outweighed and lasted only long enough to get a draw.

In the second meet the Mines were not so successful. The meet went to Boulder, the score being 15 to 10.

Boxing — Heavyweight: Gibbons of Mines was knocked out by Franklin of the University in the first round.

Wrestling, 158 pounds: Fulghum of the University was given a decision over Terry of Mines. Fulghum was much heavier than Terry, but as the two colleges could not meet on weights, Terry gave several pounds to meet Fulghum.

Wrestling, 140 pounds: Terrazas of Mines was given the decision over Velser of the University.

Wrestling, 165 pounds: Story of Mines threw Swanson of University in less than one minute.

Wrestling, 130 pounds: Lovelace of University threw Kirkwood of Mines. Kirkwood had his hand in the air as a signal that a strangle hold was being used. The referee misunderstood and gave Lovelace the match.

Boxing, 145 pounds. In order to meet weights, Adamson of Mines gave 15 pounds and met Everingen of University. The match was a draw.

The next match is to be with Denver University, and will take place before the end of the year.

Letters will be awarded to Mines men for boxing and wrestling the same as for other sports.

PROFESSIONAL CARDS

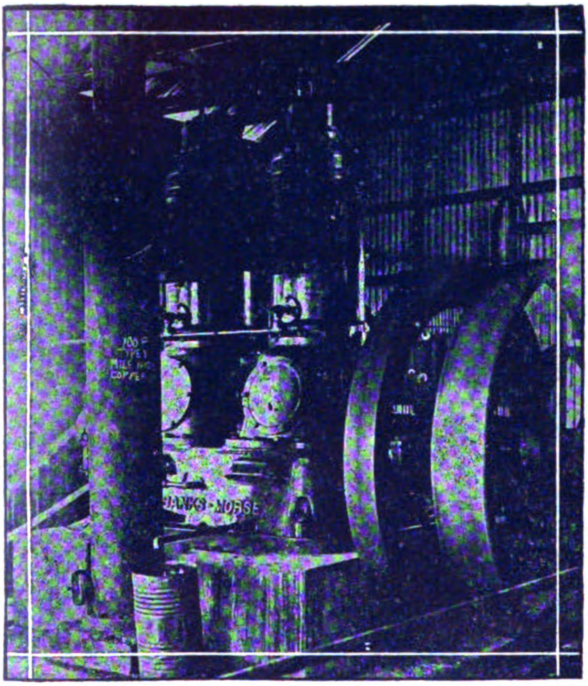
VOL. IX JUNE, 1919 No. 6

COLORADO SCHOOL OF MINES MAGAZINE

THE COLORADO SCHOOL OF MINES ALUMNI ASSOCIATION, PUBLISHERS, GOLDEN, COLO.

The Mile Wide Mine Gets Dependable Constant Power

FROM THIS 100 H. P. "Y" OIL ENGINE



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The Location of Property Lines

Wm. C. Wattles, '03.*

The Problem.

The problem of relocation of one or more previously established property lines, or the establishment of a line to conform to a deed or other conveyance, confronts the Land Surveyor on virtually every piece of work he undertakes. Its incorrect solution is generally the cause of much trouble.

Errors in location, assuming the mechanical work of the survey to be correct, are due either to insufficient information or erroneous interpretation.

The Surveyor is prone to use the most available records, to gain time, and does not make sufficient investigation into the state of the conveyances, either of the property to be surveyed, or of the adjoining lands. It is undeniable that more time spent in preliminary office work and investigation before attempting field work, will result in truer lines. It may be further stated that, in a majority of cases, the final determination and monumenting of a property line should not be made without intervening office work. The purpose of the field work is primarily to obtain physical data as to monuments and possession lines, so that a comparison may be made with the written record and a corroboration obtained. Inasmuch as a very small percent of the lines run in the field are other than transit lines for tie-in purposes, the office computations and correlation to record measurements on true lines are very necessary before final monuments are set.

Before doing any field work, the Surveyor should obtain all the information possible as to the lines to be run, and to all adjacent lines whose position may affect the ones in question. He should get the deeds and other record data covering all the property affecting the location, and the official lines of all roads and rights of way, with the ties to property lines. This data is to be platted or compared, discrepancies noted, and the most probable solution determined. The proper interpretation of the deeds must be made, giving the relative weight and preference to the various conveyances. The field work may then be intelligently undertaken, a thorough search made for original or replaced monuments, lines of possession located, and the whole tied in with closures of angles and traverses to insure accuracy.

A determinative monument is frequently overlooked or missed for lack of information on some unknown or neglected tie distance from a known point, erroneous relocation is made, and subsequently the original is found. The difficulties then presented are self-evident, especially when improvements have been constructed along the relocated line.

After the preliminary field work is completed, it should be platted, all computations made, and all work checked. Compare the positions of found monuments with their record location, determine the reliable points to be used as bases, and establish the property lines therefrom.

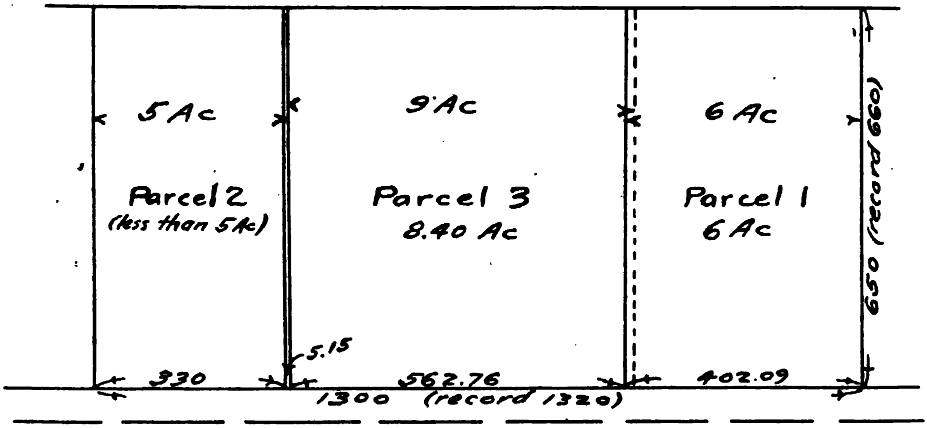
The real judgment and ability of the Surveyor is displayed and the precision of the location is evidenced in the interpretation and correlation of the record data with the field information; and to these ends the most careful analysis should be made, both of the legal features of the title and the possessory conditions on the ground.

Conveyances.

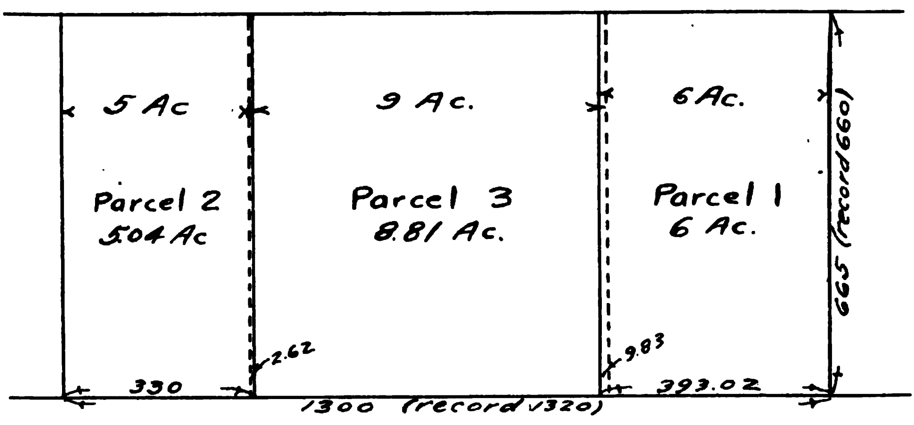
Conveyances may be divided into two general classes: first, those which designate property as a parcel, or part of a parcel, such as "Lot 6 of Brown's Subdivision", or "the southerly 100 feet of Block 10",, or "the east 15 acres of the 127-acre parcel marked 'A' on map——"; second, those which define the property by metes and bounds.

It is well to state here that some descriptions are so poorly drawn that they are impossible of construction or relocation, or else will not conform in any reasonable manner to the ground conditions. The only solution in such cases is a survey of the possessory lines, and establishment of the lines between the owners affected, by mutual quit claim deeds or by quiet-title suit in the courts. In fact, such procedure is always the best wherever lines may be placed in more than one position with equal facility. Also remember that an agreement between owners does not establish a lost line, except in cases where there exists no evidence to the contrary, or where the record is so faulty that no location can be determined by it; nor does it make title on the agreed line, unless there is a clause of conveyance therein. But it acts as an estoppel, and the Surveyor is generally safe in using the agreed line as between

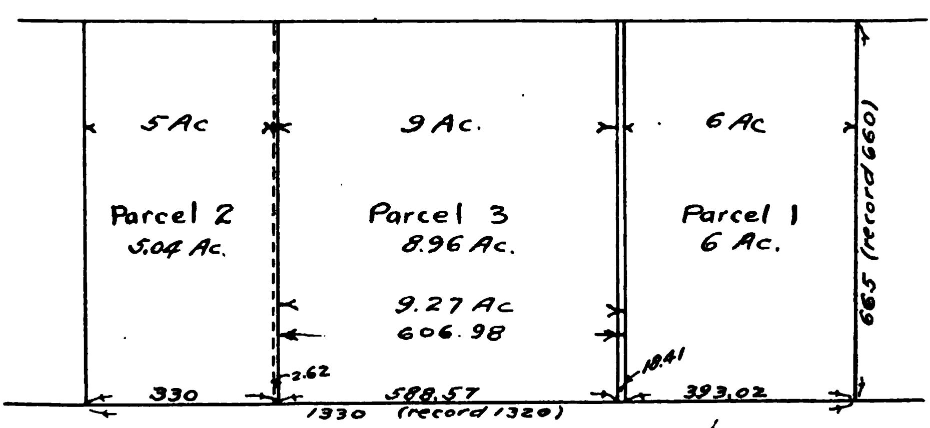
* Engineer for Title Insurance and Trust Co., Los Angeles, Calif.


5 Ac
9 Ac
6 Ac
Parcel 2
(less than 5 Ac)
Parcel 3
8.40 Ac
Parcel 1
6 Ac
650 (record 660)
5.15
330
562.76
402.09
1300 (record 1320)

CASE A


5 Ac
9 Ac.
6 Ac.
Parcel 2
5.04 Ac
Parcel 3
8.81 Ac.
Parcel 1
6 Ac.
665 (record 660)
2.62
9.83
330
393.02
1300 (record 1320)

CASE B


5 Ac
9 Ac.
6 Ac
Parcel 2
5.04 Ac.
Parcel 3
8.96 Ac.
Parcel 1
6 Ac.
9.27 Ac
606.98
665 (record 660)
2.62
10.41
330
588.57
393.02
1330 (record 1320)

the parties. It is risky, however, to use such a line as a basis for location of other work of previous date, or which is not specifically based on the agreed line.

It is a general rule that priority of recordation of instruments emanating from a common grantor, dividing a parcel of land, will govern the location in case of overlap or conflict between the adjoining properties, the lines of the first recorded deed holding, and the later conveyance suffering the loss, if any. This is subject, however, to the definiteness of the deeds. If the prior deed can not be clearly construed, the later, more definite deed, will govern; subject of course, to the corroboration of the possessory conditions.

Established Lines.

When the property to be surveyed is a parcel or lot, one of a number in a subdivision, the boundaries are preferably determined by proportionate distances between the nearest acceptable monuments. If the lot is one of regular dimensions, of the same size as a number of others in a tier, with one or both ends of the tier of odd size or shape, and the total frontage shows a decided difference in measurement from the record, indicating a probable error in the original chaining, then give all regular lots the record distance, throwing the error in the odd lot, as this was probably the system used in the original layout. Where several lines are shown parallel on the record, and one such can be well established on the ground, conforming to adjacent courses, locate the other lines parallel to such line. In general, where differences in measurement can be accepted as due merely to ordinary variation in chaining, use the proportionate method for relocation; where the differences indicate a definite error in the original work, give preference to regular shaped parcels, and even foot measurements, throwing all error in the odd shapes or distances; likewise, in such cases, hold to parallelism of lines, shown so of record, rather than to proportionate distances.

When the property in question is a portion of a larger piece, it is always well to establish all the boundaries of the larger piece, for check. If the portion is a fractional part, such as a half or a quarter, the original parcel must be run and the whole proportionately divided. If the portion is a definite part, such as the east ten acres or the south 250 feet, then the lines of the original parcel which bound the portion must be run, and the closing line must be located to give the area or distance required. The following example is a good illustration of the above:

Suppose a rectangle of ground, recorded as 1,230 feet in length, East and West, by 660 feet in width, North and South. The owner sells, first, "the east 6 acres;" second, "the west 330 feet, containing 5 acres;" third, "the east 9 acres of the west 14 acres". The Surveyor is required to locate each portion.

Case A.

All monuments of the original parcel are found and it is discovered that the true distances are 1300 feet East and West, by 650 feet North and South, a decided shortage.

The first deed calls for 6 acres, without qualification. Therefore the West line of the 6 acres is established as the line of the first deed, giving a frontage of 402.09 feet.

The second deed says, "the west 330 feet, containing 5 acres". The record measurements would give 5 acres on a front of 330 feet, but the new measurements show that more than 330 feet is required; however, the first statement is the definite frontage, the area of 5 acres being supplementary. The parcel should be laid out with a frontage of 330 feet.

The third parcel takes all east of the east line of the west 5 acres, and west of the west line of the east 6 acres. The frontage for the west 5 acres is 335.15 feet. The frontage of the third parcel will be 562.76 feet, with an area of 8.40 acres. The shortage must be suffered by the third grantee, as he is limited on the east by the west line of the east 6 acres, and he cannot extend west of the east line of the west 5 acres.

The foregoing locations leave a strip of 5.15 feet in width between parcels 2 and 3, which is still in title of the original owner. It is held by some that the grantor, by his conveyances, covering all the ground shown by record, shows a clear intent to release all his holding, and therefore has no further interest, but the wording of the deeds cannot be construed to give either the grantee of parcel 2 or parcel 3 a clear title to the 5.15 foot strip.

Case B.

The true measurements of the original parcel are found to be 1300 feet East and West, and 665 feet North and South.

As before, the first deed gets the full 6 acres, a frontage of 393.02 feet.

The second deed gets a frontage of 330 feet, an area of 5.04 acres.

The third deed takes all that is left, 8.81 acres. The west line here is determined by the east line of the 330 foot piece, the overlap to the 5 acre line, 2.62 feet, being lost. The east line must of course be the west line of the 6 acres, losing the third parcel 9.83 feet to the east line of the west 14 acres.

Case C.

The true measurements of the original parcel are found to be 1330 feet East and West, by 665 feet North and South.

Again the first parcel gets 6 acres, a frontage of 393.02 feet.

The second deed takes frontage of 330 feet, an area of 5.04 acres.

The third deed extends from the east line of the second deed to the east line of the west 14 acres, losing the overlap of 2.62 feet on the west. The net area will be 8.96 acres, with a frontage of 588.57 feet.

This leaves a strip of 18.41 feet between the west line of the east 6 acres and the east line of the west 14 acres, with title in the original owner, by a similar argument to that in Case A, for the first and third parcels are limited by their specified areas.

Case D.

The true measurements of the original parcel are found to be 1,320.85 feet by 659.44 feet.

This is apparently a difference due to variation in chaining, and the location of the three parcels is most satisfactorily made on the proportionate basis, in ratio to the areas given.

It is usually the case that the last deed out of a parcel suffers shortage, if any, but some other deed may also be found deficient in quantity (vide Parcel 2 in Case A above). However, if the last deed, by recital, conveys all the land remaining in the original piece, then that parcel may acquire all the surplus, if there be such. For example, in Case C above, if the third deed had stated, "all of said parcel except the east 6 acres and the west 330 feet," the grantee would have acquired a parcel 606.98 feet by 665 feet, an area of 9.27 acres.

Other Methods of Designating Boundaries.

When property is described by metes and bounds, the problem of location is frequently full of snares.

A parcel bounded east by land of Brown, north by Jones, west by Ash Creek, and south by the County Road, can only be located and monumented on the lines of possession and topography.

If the description gives bearings and distances, but recites courses as "along the line of A," then A's line must be followed, according to his deed, regardless of the given bearing and distance in the said description.

A point located by tie to a definite monument (stake, lot corner, street line, deed corner, etc.), by bearing and distance, should be established by such tie rather than by location from the metes and bounds. In such case the boundary is run by the record courses from the next previous tie, except the last course to the tie point in question, which last course is made to close to the tie. This system applies also to the last course of any metes and bounds description, the rule being that the final course must close to the point of beginning, regardless of recital as to bearing or distance.

The method of placing the total error in the last course to the tie point should not be rigidly followed however, for if it is apparent that the chaining differences are due to variation rather than distinct error in any one course, the better way is to proportion the lengths of all the courses to the closure. Ordinarily the assumption is made that the angles are true, although it will generally be necessary to make some variation therein to conform to the proportion of the distances.

If a description gives more than one tie for a line or point, the first will usually govern. In a case such as "thence at right angles, and parallel with 5th Street—," the construction must be based on both the intent of the grantor and the previous records of the same locality; the record may show 5th Street to be at right angles to the next previous course of the description, yet the actual official location of the Street may be a few minutes of angle different from 90 degrees; also the next succeeding course of the description may read the same distance to the Street as the next previous course to the one in question read from it, showing a clear intent of parallelism; the obvious location therefore, is to parallel the street rather than run at right angles to the previous course. The ground conditions will have considerable weight in determining the foregoing solution, especially if the angles are very much in error, say one degree or so, from the original record, or if the record shows nearly right angles and the owners have incorrectly assumed them to be 90 degrees. As another example, suppose a course to run to a point, "said point being S 89 degrees E 1,056 feet from the west ¼ Corner of said Section 15, and being also the southwest corner of the land of A. R. Johnson; thence northerly along the west line of said Johnson—;" here it is very evident that the line of

Johnson is to be followed, and the tie of 1,056 feet must be disregarded if Johnson's corner is definitely established at a distance from the ¼ corner other than stated.

Legal vs. Engineering Boundaries.

It is difficult, at times, to reconcile the legal interpretation of a metes and bounds description with the engineering point of view. In a case where the courses will not traverse, showing a distinct error, the Engineer will, logically, attempt to determine this error in some particular course, by calculating the closing course to balance the traverse, and if such closure agree in bearing with one of the courses of the boundary, throw the error into that course; this solution will prove correct in a large number of cases. Legally, the error must be placed in the last and closing course, regardless of the mathematics or the analysis of the problem. Providing the field information is not adverse, the writer believes the engineering solution to be the better and more consistent. Another sort of conflict often arises in the interpretation of bearings. Legally, all bearings are true, and should be established so from the stated meridian through the point of beginning of the course in question; this, if followed, would often result in absurdities and irreconcilable differences. The method of running lines by angles worked out from bearings given in the description, is unquestionably the best, especially if it is stated or indicated that the bearings are based on some particular line of bearing "so and so." The legal angle between "northerly" and "easterly" is 90 degrees, but the Engineer's data shows otherwise in the great majority of cases. A line "due east" is not a straight line, though generally so considered, and should be established straight, at right angles to the true meridian through the beginning point of the line.

Good and Bad Practices.

A very frequent source of poor location is neglect in running lines a sufficient length to determine their true direction. For example, it is bad practice to establish a line of considerable length, say a mile, by two stakes found therein at a short distance apart, such as 500 feet; the whole line should be run, all stakes found averaged, or the best ones at greatest distance apart taken as a base; or it may be advisable to survey cross lines, establishing the main line by record or proportionate distances from good points on these cross lines. On the other hand, a long line, shown straight by record, may have actually been staked in a very zigzag fashion, and the average straight line through stakes would present too great a deviation from the record offsets to be safe or reasonable. In such a case, small angles must be made at the most advisable points, which will keep the offsets to the found monuments within the allowable margin of error or displacement. This method of placing small angles in a long line, straight by record, should be followed even when the original monuments were placed only at the ends of the line, provided the intervening possession and later monuments are such as to justify such procedure, and the occupation is of such age as to allow of establishment by quiet title proceedings. For the purposes of analysis, however, or for adjacent location using the line in question as a tie, such line must be regarded in its record position as well as actual location.

In averaging a line of stakes, the apparent intent and original manner of setting must be examined. It is usually more advisable to adopt, as correct, stakes set at block corners rather than those at lot intersections, for they are generally transit points in the original survey, and will have been more carefully set. Any angles or offsets established in averaging a line of stakes, as proposed above are preferably located at intersection of street center lines, unless the record is specific or uniform in some other manner of monumenting.

In relocating curves, it may be stated as a general rule that, first, the measured intersection angle should be used; second, the record radius, if of even unit length or degree of curve, or the record semi-tangent, if of even feet with an odd length radius; or, third, the computed radius, if the curve be one which is evidently, by the record, established as a closure between defined lines, such as a short radius curve at a street corner compounding to two other curves, or a curve of odd length radius and semi-tangent between curves of even length elements.

To establish a point by short measurements from several directions, use the proportionate surplus or shortage of all measurements that agree, unless the point is indicated as being on the intersection of two crossed lines along which distances are taken; then the intersection of the lines will usually take precedence.

Angle points are preferably located by intersection of average lines of stakes or by distances, rather than force a record angle measurement, although the angle will have weight in determining a preference for one of two or more possible positions.

Although angles of a traverse may be more carefully read and accurately checked than the distances can be measured, with the same amount of effort, yet in practically all instances, distances hold over angles. Therefore, the Surveyor must pay special attention to the measurement of lines, particularly the tie distances. Where distances are of any considerable length, they should be chained and corrected for temperature and pull. The extra labor involved is not great and the resultant accuracy will more than repay the cost.

Monuments, if proven as occupying their original position, or a possessory line established at the time of existence of a subsequently destroyed monument, will govern any relocation, but it would be an absurdity to apply this rule so inflexibly that no allowance could be made for reasonable limits of error in survey, or a fair adjustment to conform to the evident intent of the record.

It goes without saying that the expense of a proper relocation is often greater than the client wishes to assume, or that the Surveyor will often make a price for work too little, under a misconception of the amount of labor involved; yet, if done at all, the work should be correct, and the true workman will perform his duties regardless of expense, in order to perfect the survey. The information gained will be of value in future location in the same vicinity.

Conclusion.

The methods stated in this article, though generally true, and good practice, can not be regarded as absolute, nor are there any inflexible laws fixing procedure in every case. The analysis must take in all existing conditions, and, where such exist, conform to the laws governing the case. The system of location and establishment of lines and monuments of the Government surveys is fixed and must be followed. There are certain laws covering specific instances of survey in various localities, and some districts have arbitrary systems of location which by long usage have virtually become law. The location of boundaries along water courses is fairly well specified by the legal definitions covering such boundaries.

The arguments presented herein are not intended to oppose the law, but to indicate an efficient way to reconcile the inevitable differences which arise between record and physical positions of lines and monuments.

MINING GOSSIP FROM CUBA,

By F. S. McNicholas, '14.*

Prior to the signing of the armistice, all copper, manganese, chrome and iron properties in Cuba were being worked at capacity, and great efforts were being made to increase their production to the greatest possible extent.

This was especially true of the manganese properties. As they were numerous, easy to operate, and inexpensive to acquire, a great many people took a "flier" in the mining of these ores, most of them with rather negative results.

The total production in Cuba, in 1918, of manganese ores was about 90,000 long tons, of rather ordinary furnace ore.

Immediately after the signing of the armistice, most of the manganese properties were closed down; the famous "El Cobre" copper mine was closed; the Felton iron mines, of the Bethlehem Steel Co. (with an investment of over four million dollars in equipment) closed, and a reduction of forces at the Firmeza and Daiquari properties of the same company took place. All chrome properties closed. Thus the mining boom of 1917 and 1918 in Cuba was killed by the cables of November 9, 1918, and burial took place, with fitting ceremony on November 11.

The only hopeful condition for the miner in Cuba, is the fact that big money has been made and is being made in the sugar industry, and much of this money will take a chance in supporting prospects of almost any sort, and there are possibilities in both copper and iron.

At present the only mining activity here is some little exploration work in copper, distributed all over the island. Some of the iron properties in Oriente province are being worked on small scale. The Charlotta pyrite mines, in Santa Clara province are being developed by the Davis Chemical Company. The Matahambre Copper Mines, in Pinar Del Rio province, with a Mines man in charge, D. Ford MacCormick, are being operated at capacity. The oil excitement in Havana province has subsided, although work is still in progress and some oil is being produced. Practically all the manganese and chrome properties are dead issues and will be until the next world war occurs.

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* Examining Engineer for Marshall and Keith, in Cuba.

Statistical Treatise on Petroleum

By Fred A. Lichtenheld, '20.

PART I.

Early History.

Although the petroleum industry is of recent origin, mineral oil was long used by the Indians in America, the fire-worshippers of Russia, and the people of Egypt for embalming their mummies. Pliny describes the Sicilian oil which was obtained near Agregentum and used for illuminating purposes.

At one time petroleum was used in America as a medicine, sold under the name of "Seneca Oil." It was not monopolized by any one at this time, but was carried away freely by all who cared to collect it. The existence of petroleum throughout the United States was known for many years, but it was not until 1806 that the first well was drilled to a depth of 58 feet at Kanawha, Virginia. It produced 20 to 30 barrels a day.

In the early days of the United States "coal oil" distilleries were erected, similar to those in Scotland. These produced illuminating oils from bituminous material. They developed rapidly into very prosperous business enterprises.

In 1860 there were 53 coal oil companies in existence in the United States. The average price for the manufactured "carbon oil" was about 60 cents a gallon.

When Col. E. L. Drake demonstrated that petroleum could be secured by drilling, and that it afforded an illuminating oil superior to any that could be manufactured from coal, the "coal oil" industry became paralyzed. Many of the old coal oil refineries were converted into petroleum refineries, and continued the business of manufacturing illuminating oils.

The success of the Drake well directly introduced the rapid development of the petroleum industry. Oil companies sprang up over night, the petroleum industry had just been born. Intensive development was in progress; the tide swept over the valley of Oil Creek and along the Allegheny River, above and below Oil City, for a considerable distance. Cherry Run, in 1864, and the Pleasantville oil fields in 1868, furnished the chief excitement.

From Pennsylvania, the speculative "wild-cat" prospectors rapidly extended their activities to New York, Ohio, Kentucky, West Virginia, Tennessee and California. After 1884 the production of Ohio rapidly increased, and that of West Virginia after 1890. From the same date that of California steadily increased to its present tremendous production, and Colorado and Indiana began to contribute appreciable quantities. Small productions were recorded from Illinois, Kansas, Texas, Missouri and Indian Territory at the beginning of 1870; but towards the close of the nineteenth century, Kansas and Texas began to develop their petroleum to a fuller extent, and Wyoming also appeared on the list of producing States.

From 1901 to 1905 the Eastern fields showed a decline, whereas California, Texas, Louisiana, the Indian and Oklahoma Territories, Kansas and Indiana increased their production. The Lima-Indiana fields, and the Mid-Continent fields showed a great increase in the future production of lighter grades of oil.

In 1905 a pipe line from Humboldt, Kansas, to Whiting, Indiana, was a step in the transportation of oil. Additional transportation facilities were provided by the laying of a second pipe line across the Isthmus of Panama for the delivery of the oils from the California field to the Atlantic Ocean. In 1914, when the famous Cushing field was at its maximum the prices of Mid-Continent oil began to decline. The Cushing petroleum invaded the markets of the Appalachian crudes; they, too, began a retrograding movement. When drilling to the Bartlesville sand, in the Cushing field, became popular in 1913, stocks were accumulating heavily.

During 1915 and 1916 the oil production increased, every field was pushed to the utmost. Stocks also rapidly increased, because of lack of transportation facilities. In 1917, however, the crude oil stocks started on a decline, the consumption was far in excess of the production.

If we may judge the future by the past, we will need in 1920, 390 million barrels, and in 1927, 600 million barrels.

In 1918 very few new fields were opened and only a small number of new wells drilled. Prospecting has been greatly hindered because of increased wages, increased prices for material and piping, and, in fact, it was impossible at times to get drilling materials at any price. There were drouths in the Mid-Continent section, strikes in the Gulf Coast region, and lack of transportation facilities in other sections.

Domestic Petroleum Statistics.

Per Capita Consumption of Petroleum in the United States.

Year	Approximate Annual Output	Bbl. Crude Per Capita	Uses.
1860	500,000		
1870	5,000,000	.016 Bbl.	Illuminating.
1880	26,000,000	.138 "	Illuminating.
1890	46,000,000	.525 "	Illuminating.
1900	64,000,000	.727 "	Illuminating, Fuel.
1910	210,000,000	.836 "	Illuminating, Fuel.
1914	265,000,000	2.326 "	Ill., Fuel, Automobile.
1918	345,000,000	3.400 "	Ill., Fuel, Automobile, War.

This year the consumption will fall below the average.

The Transportation of Petroleum.

One of the first problems which confronted the oil producers was that of transportation. The oil wells along Oil Creek and the Allegheny River, in Pennsylvania, were many miles from a railroad. There were often no roads, or, at the best, very poor ones, scarcely more than trails. In the early days crude oil was put into iron-looped barrels made of oak, and holding 40 to 42 gallons. These were loaded on trucks and brought to the nearest shipping point. Cars, consisting of a horizontal cylindrical tank of boiler plate, mounted on a four-wheel platform on railroad trucks, were used later when railroads were extended to the oil fields.

In November, 1860, a 6-inch pipe-line, through which the oil would flow by gravitation, was proposed. It was never constructed. The first line was laid in 1862 by L. Hutchinsen of New York, extending for a distance of three miles. Excessive leakage at the joints of the pipes rendered this unsuccessful.

In 1865 the first successful pipe-line was constructed. It was 4 miles long, and carried 80 barrels of petroleum a day. It demonstrated the thorough practicability of transporting petroleum in this way. Short lines multiplied, and pipe after pipe from producing fields to the refineries and railroad shipping points crossed and paralleled one another in every direction.

Improvements in the manufacture of pipe soon followed. In 1907 the rifled pipe was introduced. This made the transportation of the more viscous oils possible.

The pipe-lines of the United States total several thousand miles in length. They range from 2 to 12 inches in diameter.

Turf oil from the Texas and California fields is piped to the seaports and thence distributed to the various markets by tank steamers.

The General Distribution of Petroleum of the United States.

The oil-pools of the United States are grouped into certain fields. The most important of these are in the California, Mid-Continent, Appalachian, Gulf Coast, Lima, Indiana, Illinois, Wyoming and Colorado. In addition, small areas have been developed in Michigan, Utah, Missouri, Arizona, New Mexico and Alaska.

California Fields.

This State now leads in the production of crude petroleum. The principal pools in order of their importance are: Colinga, Kern River, McKittrick, Midway, Sunset, Los Angeles, Santa Maria, and Summerland.

The production is derived from rocks ranging from the upper cretaceous to the tertiary in age; most of it being obtained from the Miocene. The total thickness of the oil series is 27,000 feet, consisting of clays, sands, gravels, diatomaceous shales, which are nearly all consolidated.

The "Great Valley" is a huge syncline. The fields are located along the minor folds on both sides. Practically every known geological structure produces oil. There is much folding, and the dips are usually very steep. Some are overturned folds. These produce very large pools. Most of the reservoir sands are open and friable, the oil carrying with it large amounts of sand when it is pumped. Altogether, there are fifteen producing horizons.

Mid-Continent.

This field includes the oil pools of Kansas, Oklahoma, Caddo and DeSota, of Louisiana, and Northern Texas. The petroleum in Oklahoma and Kansas is found in the Carboniferous sandstones, but those of Northern Texas and Louisiana occur in the Cretaceous formation. The petroliferous rocks have a westward dip that is very gradual, not more than 10 feet drop in a mile. The best-known pools in the field are the Glenn, Shamrock, Yale, Cushing and Healdton. So great was the production of the Cushing pool that in 1914 the average price

Summarized Table of Oil Occurrence in the United States.

Field	Structure	Geological Age.	Kind of Rock.	Kind of Petroleum.
Appalachian	Geo.-Syncline, with subordinate Anticlines.	Ordovician to Carboniferous.	Mostly Sandstones.	Paraffin—base.
Lima, Indiana...	Anticlines.	Ordovician.	Mostly Limestones.	Paraffin—base.
Illinois	Low Anticlines.	Carboniferous.	Sandstones.	Paraffin—base, and Paraffin—Asphalt base.
Mid-Continent ...	Westerly dipping beds, Anticline.	Carboniferous.	Shales, Sandstones, mostly.	Asphalt-Paraffin and Paraffin-Asphalt—base.
Wyoming	Usually folded, Domes.	Carboniferous to Tertiary.	Mostly Sandstones.	Paraffin and Asphalt—base.
Colorado	Folded.	Cretaceous.	Sands and Shales.	Paraffin—base.
Gulf Coast......	Saline Domes.	Tertiary to Cretaceous.	Dolomite and Sandstones.	Mainly Asphalt—base.
California	Folded and faulted.	Tertiary.	Sandstones, Shales, and Conglomerates.	Mainly Asphaltic base.

of crude oil dropped from $0.937 to $0.778 per barrel. Most of the producing wells in the Cushing field were gushers, yielding 1,000 barrels of oil a day; several wells, however, produced over 10,000 barrels or more a day.

Appalachian Fields.

It embraces all the oil pools of New York, Pennsylvania, West Virginia, Southeastern Ohio, Kentucky, and Tennessee. Nearly all the petroleum is classed as of Pennsylvania grade, with exception of some of the oils from Kentucky and from a few isolated pools in other States. Most of the pools have passed their prime, and in New York and Pennsylvania production is kept alive chiefly by cleaning and deepening old wells or obtaining oil from shallow sands. Prospecting is active in West Virginia, Central Ohio, and Tennessee, but so far without definite results.

The oil-bearing rocks, which range from the Ordovician to the carboniferous in age, are chiefly sandstones, imbedded in and underlain by a great thickness of shales. With a few exceptions the geological structure of the oil sands are well-defined, alternating anticlines and synclines of moderate dip, which are seldom as much as 30 degrees from the horizontal. The anticlinal theory was first worked out in this district by I. C. White.

Gulf Coast Field.

Within this field we include areas lying in the Costal Plains region, Southern Texas and Southern Louisiana. The petroleums have been found associated with salt domes, which also carry gypsum. The oils are high in sulphur, but it can easily be removed. The most important pools of the Costal region are the Goose Creek region, Burkburnett, Spindletop, Humble and Ranger pools. Active prospecting is going on in Damon's Mound, Wichita, Electra, Ranger, and Burkburnett fields in Texas, while in Southern Louisiana the Iberia, Edgerly, Winton and Bright-Penn pools are the most active. There is a sharp decline in Louisiana oil, but a considerable increase in the Costal region which more than offsets Louisiana's slump.

Lima—Indiana, Field.

The petroleum in this field is found in the Trenton limestone and Silurian sands, varying from very shallow depths to thousands of feet. In Ohio, Indiana and North Kentucky the wells are located on the flanks of the Cincinnati anticline in lenticular sands, and on structural terraces and ravines. The "pay sands" of the Cincinnati anticline rise from great depths in the Appalachian basin, and gradually thin out as it approaches the surface in Central Ohio. Throughout the field the wells are of very small yield, but have a very steady production. Drilling for gas and oil is active in Ohio. This is necessary to sustain the supply of gas which is so essential to the industries of that region.

Illinois.

The main portion of the field is located on what is called the LaSalle anticline of Carboniferous age. This extends from the Northeastern part of the State into Southwestern Indiana. The oil reservoirs are very limited in extent, and have a distinct water line. Illinois petroleum is asphaltic, containing little sulphur. The oils are refined without employing special processes. The oil production of the State has gradually declined since 1912.

Stratigraphic Distribution of Petroleum Production. Modified After Clapp.

Age	Barrels	Fields
Tertiary	4,201,190,364	California, Gulf Coast; foreign, except Canada.
Upper Cretaceous.......	70,589,025	Marion County, Corsicana to Powell, Texas; Wyoming; Colorado.
Pennsylvania	875,731,417	Electra and Henrietta, Texas; Oklahoma; Kansas.
Mississippian	831,280,834	Illinois; one-half of the Appalachian field.
Upper Devonian.........	570,763,485	One-half of the Appalachian field.
Devonian	24,107,197	Canada.
Ordovician..............	333,094,313	Lima—Indiana.

Prices of Oils from Various Fields per Barrel of 42 Gallons.

	California	Mid-Continent	Appalachian	Lima—Indiana	Gulf Coast	Illinois	Wyoming	Colorado
1890......	....	....	....	....	....	$3.33	....	$0.84
1891......	....	....	$0.67	....	....	3.50	....	0.84
1892......	....	....	0.55⅝	....	....	3.50	....	0.84
1893......	....	....	0.64	....	....	3.50	....	0.838
1894......	....	....	0.83	....	....	6.00	$6.72	0.589
1895......	....	....	1.35	....	....	6.00	8.00	0.767
1896......	....	....	1.19	$0.67	$0.72	5.00	8.00	0.883
1897......	....	....	0.78⅝	0.48	0.57	4.00	8.00	0.86
1898......	....	....	0.91⅛	0.60	0.508	5.00	7.00	0.829
1899......	....	....	1.29⅜	0.89	0.708	5.00	7.00	1.035
1900......	$0.94	....	1.35¼	1.00	1.043	5.00	7.00	1.019
1901......	0.57	$0.862	1.21	0.85	0.284	5.00	7.00	1.00
1902......	0.55	0.88	1.24	0.87	0.221	5.00	7.00	1.22
1903......	0.30	1.04	1.59	1.16	0.418	3.00	7.00	0.892
1904......	0.28	0.97	1.62	1.08	0.337	2.00	7.00	1.152
1905......	0.37	0.52	1.31	1.18	0.268	0.81	7.00	0.897
1906......	0.50	0.45	1.59	0.90	0.522	0.745	6.10	0.802
1907......	0.41	0.402	1.74	0.90	0.844	0.677	7.00	0.822
1908......	0.35	0.387	1.78	1.03	0.600	0.672	2.343	0.913
1909......	0.36	0.364	1.62	0.91	0.780	0.64	1.57	1.023
1910......	0.65	0.383	1.36	0.83	0.77	0.56	1.718	1.015
1911......	0.55	0.472	1.35	....	0.60	0.63	0.810	1.005
1912......	0.65	0.694	2.00	....	0.90	0.75	0.660	0.973
1913......	0.55	0.937	0.95	....	1.07	1.296	0.570	0.926
1914......	0.48	0.77	1.98	1.14	0.85	1.60	0.493	0 902.
1915......	....	0.55	1.59	1.18	0.45	1.52	0.472	....
1916......	....	1.26	2.50	1.29	0.90	1.53	0.561	....
1917......	....	....	....	....	....	....	1.722	....
1918......	....	....	....	....	....	....	....	....

Colorado—Wyoming.

Oil is found in Wyoming in almost any place that shows a good structure, while in Colorado the petroleum area is very limited. The chief oil-bearing formations range from the Permo-cambrian up through the Tertiary, the Cretaceous being the most important.

Almost all the oil is obtained from anticlinal folds, or domes, and a small production of oil in Colorado from faulted horizons. The dips are, as a general rule, very steep and well pronounced. Wyoming is, at present, very active. The extensive development is producing many new oil pools. Among the proven areas are the Salt Creek Dome, Big Muddy and Grass Creek. The most promising areas are near Lusk, Wyoming, known as the Lance Creek field. There is little or no prospecting being carried on in Colorado this year. A few wells have been drilled, but without any great success. The oils of Colorado and Wyoming are rich in gasoline, about 30 to 40 percent extract is made from Wyoming oils.

Associations of Oil and Coal.

Oil is sometimes thought to be associated with coal deposits because petroleum and coal occur in the same locality in different parts of the country. This assumption is not true because we find oil in places where no coal exists, especially in California. It happens that coal and oil are found among sedimentary rocks. About 50 percent of the oil fields are among coal lands, the other 50 percent are not associated with coal.

Royalty.

The rate of royalty is ordinarily a fixed one, although the conditions vary much with the age of the well. The rate is usually expressed as one of the following fractions: 1-10, 1-8, 1-6, 1-5 or 1-4, with 1-8 the most common. The difference between 1-10 (10 per cent), and 1-8 (12½ per cent), is only 2½ percent, yet the difference between 1-5 (20 per cent), and 1-4 (25 per cent), is 5 percent. These differences are not as fully realized as they should be. The negotiator should keep in mind the percentage equivalents of fractional rates and their difference as shown in the accompanying table:

Fraction	Percentage	Difference in Percentage
1-2.......	50	......
1-3.......	33 1-3	......
1-4.......	25	16.33
1-5.......	20	5.00
1-6.......	16 2-3	3.33
1-7.......	14 2-7	2.29
1-8.......	12 1-2	1.79
1-9.......	11 1-9	1.39
1-10......	10	1.11
1-11......	9 1-11	0.91
1-12......	8 1-3	0.76

Spacing of Wells		Texture of Sands and other Factors—High-Pressure Slope, etc.
Fields	Spacing	
Cushing, Okla.	1 well to 8 acres.	Sands porous.
Oklahoma	1 well to 1 to 10 acres.	Sands porous.
California	1 well to 5 acres.	Deep dip, gas pressure.
Baku, Russia	3 wells per acre.	Very porous and thick sand.
Roumanian	2 to 5 wells per acre.	Sands porous.
Louisiana	Very close.	
Dip of Beds— Small	1 well to 5 acres.	Also depends on dip, porosity, pressure of overlying strata.
Flat-lying— Strata	1 well to 6 to 40 acres.	
No fear of attack from neighbors	1 well to 1 to 10 acres.	

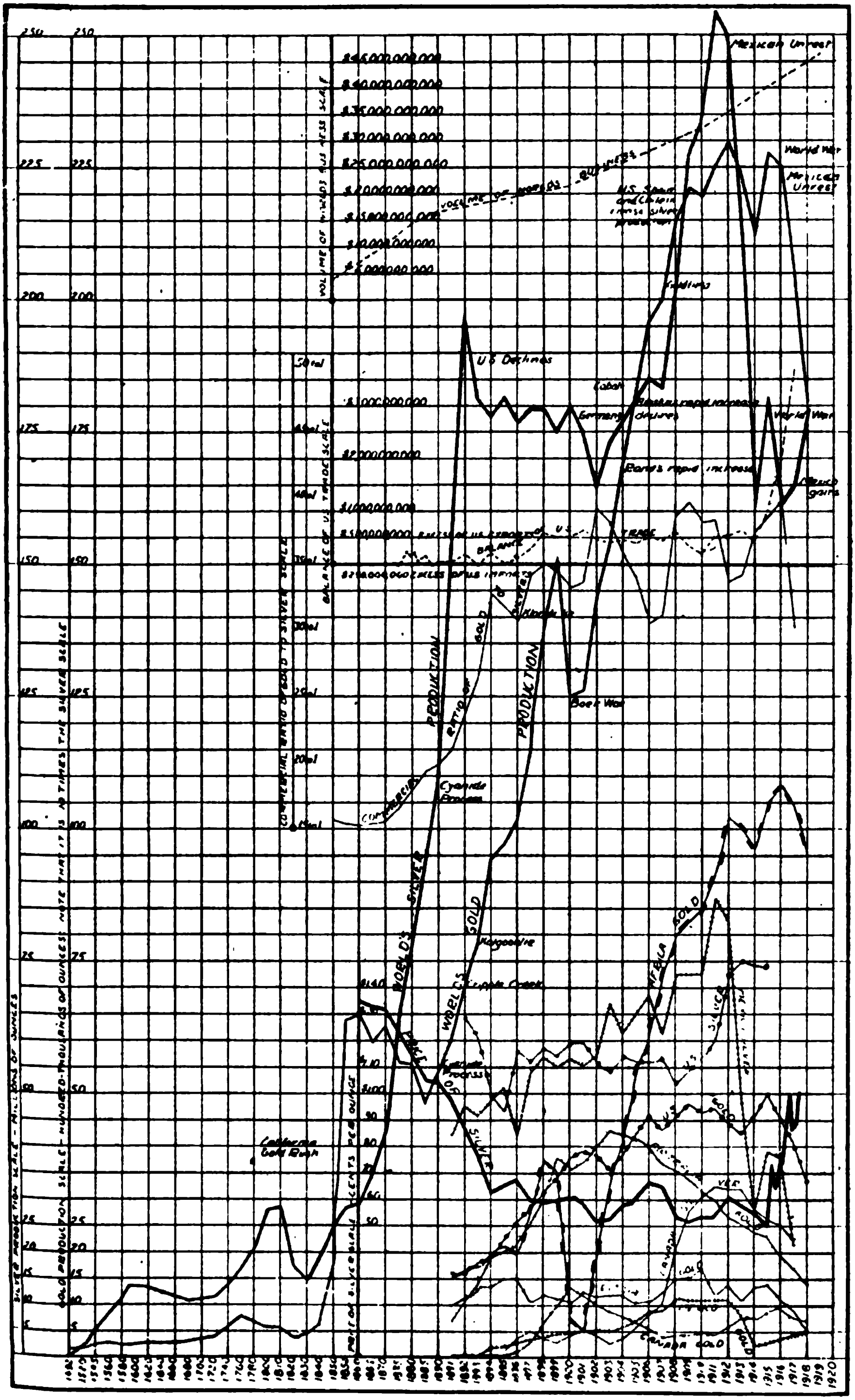
Structural Relations of Petroleum Occurrence of the World.

Structure	Percentage of Occurrences	Definition of Structure
Anticlinal or Synclinal.....	37	ANTICLINE (Syncline) a surface with inclinations out (in) from (toward) a point or axis.
Domes	26	DOMES—Is a surface dipping outwardly in all directions from a central line or point.
Joint Cracks	10	Small fractures which divide rock masses.
Sealed Faults	10	Structure that has been faulted, thus sealing in oil and gas.
Sealed in by Asphalt Deposits	10	Oil structure in which the volitable matter has escaped, giving rise to asphaltic dykes, thus sealing in the oil below.
Contact Sedimentary and Crystalline Rocks	7	Intrusion of igneous rocks into sedimentary oil-bearing rocks.

Average Life of Oil Well and Fields—Their Production and Area Per Well.

Location	Producing Period of Fields in Years	Producing Period of Wells in Years	Production in Barrels per Acre	Thickness of Sands in Feet	Area per Well, Acres
Appalachian	..	7	1,000	..	..
Texas—					
Spindletop Pool.	10	6	160,000 / 6,000	.. / ..	.. / ..
California—				..	..
Kern River....	..	6	26,000	..	..
McKittrick	..	6	5,920	..	..
Coalinga	..	6	1,400	..	..
Coalinga	6	..	12,600	73	8
Coalinga	6	6	26,900	121	5
Midway—					
Sunset	3	..	2,571	87	10
Sunset	4	..	15,127	136	4
Sunset	3	..	60,074	118	5
Sunset	2.75	..	15,747	287	3
Oklahoma—					
Glen Pool......	7	..	1,500 to 15,000	..	..
Cushing Pool..	3.5	..	535	..	..
					..
Peru	..	15	...	..	..
Canada	..	..	375	..	..
Roumania	..	..	67,500 / 225,000	.. / ..	.. / ..
Russia—					
Baku	..	10 to 20	2,200,000 / 1,200,000	.. / ..	.. / ..

(To be continued in July issue.)



Graphs of Gold and Silver Statistics.

[This is a repetition of the cut which appeared in the May issue, accompanying an article on gold and silver statistics. Because the original cut was so ineligible this repetition was deemed advisable.—Editor.]

IDLE HOUR

FACTOR WHICH MUST BE CONSIDERED IN DECIDING BETWEEN MULE AND POWER HAULAGE FOR UNDERGROUND WORK.

a. For Motor Haulage:
1. Large tonnage to warrant investment.
2. Long haul over 1 mile.
3. Good track; grades not more than 0.5%.
4. Cheaper power.

b. In Mule Haulage:
1. Small or uncertain tonnage.
2. Short haul—not over 1½ to 2 miles
3. Fair or poor track. [Grade does not have to be uniform. Short distances may have grades as high as 2.5 to 5%.]
4. Where material cannot be handled in long trains.

Carbon Disulphide (CS_2) when passed over metallic oxides at a red heat yields metallic sulphides, sulphur dioxide and carbon. This must be done in an atmosphere free from oxygen.

LIQUID AIR.

Costs $2.00 per gallon to produce. Requires approximately 20 h.p. to produce 1 gallon per hour.

At a pressure of 1,000 lbs. per sq. in. the time of liquification is 14 minutes

At a pressure of 2,000 lbs. per sq. in. the time of liquification is 6 minutes

At a pressure of 3,000 lbs. per sq. in. the time of liquification is 1.5 minutes

Most economical pressure is 2,500 lbs. per sq. in. At this pressure 150 grams of liquid air are produced for each horsepower hour:

$$\text{Efficiency} = \frac{\text{Work done by Liquid Air}}{\text{Work required to produce Liquid Air}} = 2\tfrac{1}{2}\%$$

TUBE-MILL DATA.

The following data gives the outside limits of crushing capacities that may be expected in a Conical Ball Mill. The variations in tonnage depend upon the hardness of the ore, size of feed and desired fineness of the product:

Diameter	H. P.	Tonnage Day
3 feet	6	25 to 50
4½ feet	15	50 to 80
6 feet	35	150 to 350
8 feet	112	550 to 800

COVERING FOR CONCENTRATION TABLES.

Linoleum has generally been used for this purpose, but has not been entirely satisfactory because the cyanide solution used in ore recovery blisters it, thus making its life short.

Recently a new material has been successfully tried, especially in gold recovery. It is a cotton-base fabric having a pyroxylin coating. It is thinner and desidedly more pliable than linoleum, but is as waterproof as rubber.

The Portland Mill of Victor, Colorado. has operated one of its tables, covered with this material, continuously for a year without change. It showed no blistering and little deterioration otherwise.

The material was designed originally to be used for automobile and furniture upholstering—it is a leather substitute, in fact.

Mr. Thomas B. Crow, Manager of the Portland Mill, and Mr. Luther Lennox. Asst. Mill Superintendent, invite mining and concentrator men interested in this subject to write them for any additional information desired.

TAMPING.

Miners, quarrymen and contractors generally realize the importance of tight tamping and of using proper tamping material. But proper tamping materials are not always available, so they use whatever may be near at hand with the result that more explosives are often used than are necessary, increasing costs, or bringing down less coal or rock than could reasonably be expected from the quantity of explosives used. Use heavy paper tamping bags—fill them with sand, clay or any powdered material and you will find your powder-bill decrease.

OASES IN THE MUD.

One American soldier-humorist has remarked that Brest, the French city from which the boys start for home, is about four miles square and four miles deep. Since the rains have made that place a quagmire of mud, the efforts of the Red Cross have been devoted largely to supplying a few dry spots, and the little rest huts with something to read and a place to smoke in dry comfort, are greatly appreciated.

Sodium sulphide (Na_2S) has been successfully used in the flotation of oxidized, as well as free, gold ores.

TECHNICAL REVIEW

GENERAL.

The Winning of Oil From Rocks. By Arthur J. Hoskin. (Mining & Scientific Press, May 24, 1919.)

The existence of oil-shales has been known since days of the early settlers. They were supposed to have been a low-grade coal. Most writers on oil-shales lay too much stress on those of France, Germany and Scotland. Comparisons are liable to be erroneous. The writer confines his attention to the American oil-shale industry.

Bituminous-Shale would be a better name. Oil is produced by application of heat and condensation of vapors emitted.

Shales vary from a few feet to hundreds of feet in thickness. Bituminous and non-bituminous strata blend one into the other; they also frequently alternate in layers. Richness depends upon "kerogen" or "organic remains" content. Average grade shale yields 42 gallons of oil per ton. There are many varieties of shales, each producing slightly different products.

Much land is still available, although that most accessible to railroads has been located. It is located as a placer-claim.

Methods of mining will vary from open-cut, coal-mining to metal-mining, dedepending upon manner of occurrence.

Briefly describes various processes used. The refining of the shale-oil is similar to well-oil. Products are quite different. Shale-oils produce mostly lubricants and greases. Briefly mentions the by-products and their possibilities. Believes that attention should be first concentrated on recovery of oil. With this perfected, processes for the recovery of the by-products will be gradually evolved. C. E. W.

The Divide District. By Frank L. Sizer. (Mining & Scientific Press, May 10, 1919.)

The Tonopah Divide Mine on Gold Mo"ntain is only about five miles from Tonopah. The geological features of importance are pronounced parallel fissures. So far the Tonopah Divide is the onlv mine with very rich ore, but the parallelism of veins would indicate the same origin and same conditions of ore deroosition in each vein. At the present time the Divide shaft is down 570 feet, and cross-cutting to the vein is being done. Their ore averages seventy dollars and in places runs as high as 2,000 ounces of silver. As soon as the Rhyolite cap which covers the Divide Breccia is penetrated it will be possible to determine whether or not the ore will continue with depth. R. J. Parker.

Mine Development in China. By Gilmour E. Brown. (Mining & Scientific Press, May 17, 1919.)

Due to the complexity of legislation and the lack of adequate mining laws it is now almost imposible for a foreigner to get a beneficial mining concession. Local permits are always interfering with government concessions. Another great drawback is the four months necessary to get a permit to purchase explosives. Chinese labor is very cheap but so inefficient as to make the average cost per ton mined higher than in the United States. R. J. P.

Examining a Prospect in Alaska. By F. Le Roi Thurmond. (Mining & Scientific Press, May 3, 1919.)

A very good and interesting account of the examination of a prospect may be found in the May 3 issue of the Mining & Scientific Press. R. J. P.

Bituminous Roofing Materials and Construction. By G. L. Wilson. (Chemical and Metallurgical Engineer, May 1, 1919.)

Bituminous roofings may be either "built up" roofings or prepared. In general the "built up" consists of alternate layers of pitch and felt capped by crushed gravel. The prepared bituminous roofings are simply one or two layers of felt cemented together with bitumen. Those consisting of a single layer of felt covered with bitumen are commonly known as "rubber" roofings. Prepared roofings are generally put up in rolls of 100 sq. ft. but may be purchased in shingle form. In purchasing any roofing material the tests should be made to determine thickness, tensile strength, absorption of moisture, pliability, volatility at maximum summer temperature and the amount of inert mineral filler.

R. J. P.

Metallic Coatings for Rust-Proofing Iron and Steel. By Rawdon, Grossman, and Finn. (Chemical and Metallurgical Engineer, May 1, 1919.)

Corrosion of iron is due in general to the electrolytic action between the iron itself and its protective coating of an electro-negative metal. Zinc is the only common metal electropositive to iron, and is therefore a good protection. It may be applied to hot-dipping, sherardizing (exposing to zinc vapor), and by electroplating. The soft, fusible metals as tin and lead are often used and where the iron is completely covered so that no electrolitic action may take place, they are excellent. Copper, nickel, cobalt and brass form good coatings, but tend to flake off under rough usage. Iron is often given a thin impervious coating of ferric oxide and then reduced by heating in carbon flame to magnetic oxide, which forms a very good protector. The merits of all these coatings may be proved by various tests. These tests depend upon the corrosive action of oxides, lead acetate, salt water and other common corrosives. R. J. P.

The Geology and Economics of Coal. By J. R. Finlay. (Eng. & Min. Jour., May 31, 1919.)

The author gives a non-technical description of the mode of formation of coal. He emphasizes the fact that the large areas of peat-bogs, so prevalent the world over, in this age, are but coal measures in the incipient state of formation; all they require is to be buried by some sort of a sedimentary rock formation to complete the process. How the geologic processes are wrought is lucidly described by drawing analogies between the present dav phenomena and those of the great coal formation periods of past geologic ages.

The article is concluded by data on coal production and consumption statistics. C. E. W.

Photography in Research. By Arthur G. Eldredge. (Chem. & Met. Engineering, May 15, 1919.)

A general article calling attention to the possibilities of the microscope and camera in all branches of research. The value of the motion-picture camera, the method of its utilization in conjunction with the miscroscope, in studying reactions too fast for the eye to comprehend, is explained. Attention is also called to optical limitations. C. E. W.

METALLURGY AND ORE DRESSING.

Economics of Concentration. By A. P. Pratt. (Engineering & Mining Journal, May 3, 1919.)

There are two types of percentage recovery to be considered in anv milling operation: metallurgical recovery on the percentage of valuable mineral saved, and economic recovery on the percentage of gross value recovered as net profit. A plant with low metallurgical recovery may be operating at a profit and one with high metallurgical recovery may operate at a loss. This applies especially to small plants with low-grade ores. A large tonnage of concentrate does not necessarily mean increased profit.

Examples are cited showing that it is not profitable to attempt to mix a large amount of low-grade concentrate with high-grade material.

Formulas are given for determining the extent of concentration beyond which there are no profits.

Retreatment plants are considered advisable for making a higher grade product as well as checking the mill work. W. B. Case.

Electrolytic Refining of Gold and Silver. By G. G. Griswold. (Eng. & Min. Journal, May 3, 1919.)

First electrolytic gold and silver refinery was built by Kansas City Smelting and Refining Co., Argentine, Kans., in 1885. The tank room that is now used contains 24 sections of 6 tanks each, the sections being in series and the tanks in multiple. The anodes weigh 100 ounces. The cathodes are made from cold rolled silver sheets 1/32 in. thick. The electrolyte is neutral nitrate solution containing 15 to 20 gm. silver and 30 to 40 gm. copper per liter. Gold slime is purified by boiling with H_2SO_4 66° Bé and refined by Wohlwill process in which platinum and pallodium are also obtained. W. B. C.

Froth Flotation. By V. F. Standley Low. (Mining Magazine, April, 1919.)

The writer reviews the history of froth flotation as developed at Broken Hill, Australia. C. E. W.

Basic Refractories for the Open Hearth. By J. S. McDowell and R. M. Howe. (A. I. M. E., May, 1919.)

The first basic hearths were constructed of burnt lime. Following burnt lime, dolomite bricks were used and finally magnesite bricks covered with a layer of cintered magnesite. The later material however became scarce and so a special dolomite refractory was used.

It is claimed that pure magnesite ranks first among the refractories in the resistance to slaking and corrosive slags, but neither pure lime nor magnesia have much value as refractories.

O. H. M.

Leaching of Oxidized Copper Ores With Ferric Chloride. By R. W. Perry. (Mining & Scientific Press, May 17, 1919.)

The ore is in an altered monzonite gangue and is completely oxidized. The copper is present as malachite with small amounts of cuprite and silicate. The ore is crushed through a 20-mesh screen and agitated for seven hours at a temperature of 70° C. in a solution of ferric chloride decanted or filtered and the copper solution is pumped into revolving drums. Here the copper is entirely precipitated on iron turnings. The reaction between the ferric chloride and copper reduces the former so that before using the solution over it must be oxidized. This is accomplished by electrolysis. The ferrous chloride is oxidized and metallic iron deposited on the cathode. Loss of chloride requires addition of several hundred pounds of hydrochloric acid per day. This must be manufactured at the plant and is probably the weakest point in the treatment.

Some percolation tests on 10 kilogramme lots resulted in extractions varying from 6% on $-10 + 40$ mesh to 87% on $-20 + 80$ mesh. But the finer ore is much more difficult to decant and filter so that an average of 20 mesh was used, giving about 80% extraction.

R. J. P.

Sintering Zinc Residues. By K. Strock. (Chem. & Met. Engineer, May 15, 1919.)

The Rocky Mountain zinc ores carry enough silver and gold as to make the sintering of the retort residues pay. The zinc and lead is burned off, leaving all the silver, gold and at least five per cent lead. The resulting clinker is very porous, full of carbon and a very good blast furnace material. The residues are placed over a series of brick air passages and wood. The wood is ignited and air blast turned on. The burning takes at least 35 days, after which the air is shut off and the whole mass is kept continually wet for three days. The pile is broken up by powder, loaded into cars and shipped to a lead plant. The cost of sintering is about $1.53 per ton of clinker produced.

R. J. P.

A Proposed Metallurigcal Process for the Treatment of Vanadinite for the Recovery of Lead and Vanadium. By J. E. Conley. (Chem. & Met. Engineering, May 15, 1919.)

The ore tested came from near Ray Junction, Ariz. It contained mostly vanadinite and quartz, with small amounts of wulfenite, galena, calcite and iron silicates.

The following methods proved unpromising:

1. Alkaline leach with Na O H and Na_2CO_3.
2. Acid leach with sulphuric and hydrochloric acid.
3. Fusions with nitre-cake, soda-ash and sodium nitrate, and nitre-cake and charcoal.

Fusion with soda-ash and caustic soda most promising method. Charcoal may be used to reduce the lead and increase its extraction, but before fusion is completed an oxidizing agent must be added to obtain the vanadium in the form of V_2O_5, which is more water-soluble.

Silica and molybdenum are precipitated with lime and vanadium pentoxide, subsequently with sulphuric acid. An 86 percent recovery was made. A list of the other precipitates used and their results are given. Estimated treatments costs are included.

C. E. W.

Treatment of Cuprodescloizite for Extraction and Recovery of Vanadium, Lead and Copper. By J. E. Conley. (Chem. & Met. Engineering, May 1, 1919.)

The sample of ore treated came from the Shattuck-Arizona Copper Co., of Bisbee, Ariz., and contained 8.06% V_2O_5, 7.31% CuO, 23.02 % PbO, 2.36% Fe and 52.50% insol.

Concentration by screening gave poor results. In this particular ore the Cuprodescloizite was very intimately associated with the quartz-gangue. No attempt at gravity concentration was made. Object was to determine best method of extracting the vanadium, lead and copper.

The following methods were tried:

1. Leaching with hydrochloric acid, 70% extraction; feasible commercially.
2. Leaching with sulphuric acid; satisfactory.
3. Treatment with concentrated sulphuric acid under pressure; not satisfactory.
4. Fusion with nitre cake; two-thirds ore decomposed, remainder leachable in acid.
5. Volatilization of vanadium as oxytrichloride with chlorine and as the tetrachloride with hydrochloric acid gas; very interesting possibilities.
6. Fusion with soda-ash, and soda-ash combined with either caustic soda or salt; not very satisfactory, 35 to 70% extraction.
7. Chloridizing roasts with salt and sulphur; poor.
8. Combination of nitre cake-sulphuric

acid treatment; most successful and commercial.

About 90% of the lead sulphate is recovered by sliming. Copper recovered as cement-copper by precipitating with scrap-iron. Solution is then carefully neutralized with caustic soda and vanadium precipitates out as iron vanadate. 50% V_2O_5 iron vanadate obtained. 90-95% extraction. Estimated costs are given. C. E. W.

MINING.

Internal Corrosion of Cables. By W. F. Robertson. (Mining & Scientific Press, May 3, 1919.)

An accident caused by the breaking of a hoisting rope resulted in the death of 16 men at Nanaimo, B. C. Investigation showed that although the cable was apparently in good shape and examined every day and that the cable was repeatedly lubricated with black oil, the inside strands were badly rusted. The cable broke about 180 feet above the cage and tests showed that where it had been exposed to the action of shaft water it had been corroded internally and was really rust-rotten. The investigators recommended that cables be heated and soaked in hot oil periodically to properly waterproof them.

At the Anthracite Mines, South Russia. By Dr. A. L. Simon. (Mining Magazine, April, 1919.)

The author gives his experiences in this region from the early days of the war, in 1914, to December, 1915. He describes the mine-pumping system, boiler-house, hoists, and occurrence of the coal. In addition he portrays the labor's social and racial characteristics.

C. E. W.

GEOLOGY.

The Elm-Orlu Case. By Robert M. Searles. (Mining & Scientific Press, May 10, 1919.)

An excellent abstract of a very peculiar case of extralateral rights dispute is treated in the May 10 issue of Mining and Scientific Press. Clark-Montana vs. Butte and Superior Co., in which a large, rich ore body was awarded to the Clark-Montana Co. R. J. P.

Geology of Diamond Region of Bahia, Brazil. By R. Crandall. (Economic Geology, May, 1919.)

The rocks exposed in this region are: Archean gneisses and schists with intruded granites, Jacobina quartzites, sandstones and shales, Tonibordo sandstone, Jacuipe flints, Caboclo shales, Parghassu shales and sandstones, lavas, conglomerate and sandstone (this conglomerate carries the diamonds). Estancia shales, Salitoe limestones, and the gravels and river-bed deposits. The geology of each important part of the district is treated fully in this article.

R. J. P.

Nickel in Alaska. Official Sources. Mining Review.

Nickel occurs in three localities in Alaska, viz: on the west coast of Chichagof Island, near Copper River, and on Knight Island of Prince William Sound. The deposits of Chichagof Island and those near Copper River were examined in the summer of 1917, by R. M. Overbeck, of the United States Geological Survey.

The deposits of the Chichagof are the only ones that have been developed to any extent. The development consisted in 1917 of a 180-foot shaft with 155 foot drifts at the 80- and 180-foot levels and several prospect holes.

The ore occurs at the margin of a mass of hornblend-gabbro, or norite, which is intruded into quartz-mica schist. The ore is exposed in two outcrops about half a mile apart. The shaft is sunk at one of these outcrops. A third outcrop occurs farther north where a mass of limonite is believed to be the weathered capping of an ore-body.

The ore minerals are chiefly sulphides and consist of pyrrhotite, chalcopyrite and pentlandite. Two selected samples of ore from the 80-foot level contain 4.08 and 3.93% of Ni and a trace of Co.

The number, size and shape of the ore deposits is unknown on account of lack of underground development. The ore-bodies are not very extensive and hence do not warrant large investments in facilities for mining and ore treatment. The amount of ore developed and the geologic conditions encourage the hope of developing large ore-bodies, with a reasonably small amount of money.

O. H. M.

Occurrence of Elaterite, or Elastic Bitumen, in a Fluorite Vein at Modoc, Ontario. By Cyril W. Knight. (Canadian Mining Journal, June 4, 1919.)

On the 200-foot level of a fluorite mine near Modoc, Ont., elaterite was found in sparing quantities. It is dark brown in color and occurs in rigs. Ledoux and Company made an analysis of the material and pronounced it elaterite or a similar bitumen. The origin is obscure but is probably the same as the fluorite.

Speculation is aroused as to the possibility of large commercial deposit in adjoining areas and much prospecting is being done . R. J. P.

Relation of Ore Deposits to Thrust Faults in the Central Wasatch Region, Utah. By B. S. Butler. (Econ. Geol., March-April, 1919; Vol. XIV, No. 2, pp. 172-175).

The presence of reverse and thrust faults in the Wasatch Range has been known for some time but the relation of ore-deposits to such faults has been recognized only recently by F. C. Calkins and F. F. Hintge. Several million dollars worth of ore have been taken from deposits associated with thrust faults in the Big and Little Cottonwood Districts, Utah.

Sedimentary rocks ranging in age from the Pre-Cambrian to the Jurassic, several thousand feet thick, have been affected first by normal faulting, then by folding and thrust faulting, next by intrusions of igneous rocks accompanied by reverse faulting, and finally by normal faulting. The largest thrust fault had a displacement of thousands of feet, causing the pre-Cambrian rocks to override the Carboniferous.

Several important ore deposits occur in the breccia of the thrust faults along their intersections with younger fissures. The shoots are irregular and are of replacement origin. Both the brecciation and replacement occur most extensively in limestone. The mineralization is apparently dependent in part on the chemical composition of the limestone. Breccia formed from certain beds is more extensively and completely replaced than that formed from other beds.

The largest thrust is the Alta compound-fault. Along this are found the ore-bodies of the Cardiff and Columbus-Rexall mines, and of the western deposit of the Wasatch Mines C.

F. M. V. T.

OIL.

Study of Oil and Gas Possibilities of the Holbrook Area. By Dorsey Hager. (Mining Review, May 15, 1919.)

The area described is approximately 400 sq. mi. around Holbrook, Ariz. The rocks exposed are largely Mesozoic and late Paleozoic.

Several promising structures with a minimum closure of from twenty-five to fifty feet have been found. Excellent oil sands are known to exist down to 2,000 feet. No faults or intrusions are known to exist so that the only point in question is the actual occurrence of oil and the underground circulation. One well has been started near Holbrook with the intention of testing to a depth of at least 2,500 feet. R. J. P.

Petroleum in Ecuador. By W. E. Brodie. (Engineering & Mining Journal, May 31, 1919.)

Oil has been produced in small quantities for over a half of a century at Santa Elena. Here Post-Tertiary formations are exposed. The oil zone is supposed to cover at least 600 sqare miles. Pits about 40 feet deep have been worked for years. Oil and water seep in and is hoisted into tanks and allowed to separate. The oil is then transferred to steamers. One well 1,700 feet deep produced a very good motor oil. The one drawback is the governmental opposition to granting concessions, and it is rather difficult to get deep development done under the present laws.

CATALOGUES.

The Jeffrey Mfg. Co. has just issued a new catalogue number 258 on "Jeffrey Standard Apron Conveyors".

This catalogue contains 74 pages, devoted to installations showing Standard Steel and Wood Apron Conveyors in service in various industries, specifications, general dimensions and other important data of vital interest to the purchaser.

The Jeffrey Standard Apron Conveyors, both of steel and wood flights, are so arranged in this book that not only the Engineer, but the layman, who is more or less unfamiliar with conveying machinery, can easily select a conveyor which will completely meet his requirements.

There are no confusing tables to contend with. On pages 4, 5, 6, 7, 8, 9 will be found some important notes to aid the purchaser in selecting a conveyor.

This catalogue will be of special advantage to the purchaser as he will save the time and expense heretofore required in making drawings and layouts for his own particular needs. In addition the purchaser is further benefited by quick delivery and saving in special designing cost made possible by placing Jeffrey Standard Apron Conveyors upon a manufacturing basis.

The B. F. Goodrich Company, of Akron, Ohio, has sent us two catalogues which should be of value to mining and millmen. One is entitled "Goodrich Rubber Belting". It contains a general description of transmission and conveyor belting and invaluable technical data pertaining thereto.

The other is called "Goodrich Rubber Hose and Tubing." If you wish data on rubber hose or tubing of any sort you'll find it in this catalogue.

The Hercules Powder Co. has recently issued a catalogue called "Hercules Products." This book should prove valuable to mining men and other users of explosives. It contains a general description of all the products that are manufactured by the company. If you wish a copy write to their nearest office.

The Fairbanks, Morse and Co. has a new catalogue No. 92 D on "Y" Oil engines, Style "H." This book contains a full description of this standard oil engine, its construction, special features and performance. Send to their nearest office for a copy if you are interested.

DISCUSSION

LICENSE BILL FOR COLORADO ENGINEERS.

An Act.

Senate Bill No. 339.

By Senator Knaus and Mr. Finley.

Creating a State Board of Engineer Examiners and Licensing Engineers in the State of Colorado.

Be It Enacted by the General Assembly of the State of Colorado:

Section 1. Within sixty days after the taking effect of this act the Governor of the State shall appoint a State Board of Engineer Examiners, to be composed of five members, who shall be legal residents of the State of Colorado and who shall have been engaged in the practice of engineering for at least ten (10) years. Two of said engineers appointed as examiners shall hold office until April 1, 1921, and two until April 1, 1923. The State Engineer shall be ex-officio the fifth member of the Board. The members of the first board shall receive a certificate of appointment from the governor, which shall entitle them to a license under this act.

Sec. 2. Upon the expiration of the term of any members other than the state engineer the governor shall appoint their successors for a term of four years, from a list of five nominees elected by the licensed engineers acting in a general assembly called together for this purpose by the president of the board. Such assembly shall be held in the month of January next preceding the expiration of the terms of any members.

Each member shall hold over after the expiration of his term until his successor shall have been appointed and qualified.

The Governor shall appoint a licensed engineer to fill any vacancv occurring in the Board for the unexpired term of such membership. Said appointment shall be made within thirty days after such vacancy occurs.

Sec. 3. The members of the State Board of Engineer Examiners shall, before entering upon the discharge of their duties, make and file with the Secretary of State the constitutional oath of office for the faithful performance of their duties. They shall, as soon as organized, and annually thereafter, in the month of April, elect from their members a president. The State Engineer shall act as secretary and treasurer.

Sec. 4. The Board of Examiners shall adopt all necessary rules, regulations and by-laws to govern its proceedings, not inconsistent with this act or the laws of the State or of the United States. The Board shall adopt a seal, and the secretary shall have the care and custody thereof, and shall keep a record of all proceedings of the Board, which shall be open at all times to the public.

Sec. 5. Each of the members of the Board shall serve without compensation other than necessary expenses incurred attending meetings of the Board and in conducting examinations, which, together with all other lawful expenses, shall be paid from a fund as hereinafter provided, and in no case shall any of the disbursements of the Board be a charge against the State of Colorado.

Sec. 6. The fees derived from the operation of this act shall be paid into the State treasury into a special fund designated "Engineer Examiners' Fund," which shall be held exclusively for the purposes of this act and shall not revert to the general fund. Warrants for the disbursement of funds accumulated by the operation of this act shall be issued by the auditor of state upon presentation of vouchers authorized at any meeting of the Board and signed by the president and secretary.

Sec. 7. Within the first week of December after the organization of the Board, and annually thereafter, the Secretary of the Board shall file with the auditor of state a full report of the proceedings of the Board.

Sec. 8. The Board shall hold two or more meetings each year at intervals not exceeding six months, pursuant to the call of the president or any three members of the Board. A majority of the members shall constitute a quorum.

Sec. 9. An Engineer, within the meaning of this act, is a person who is engaged in the practice of the profession of engineering in any of its branches, except military engineering.

Sec. 10. The Board shall admit to examination any candidate who pays a fee of ten dollars ($10.00) and submits evidence verified by oath and satisfactory to the Board that he:

(1) Is a citizen of the United States and is more than 25 years of age, and

(2) Is of good moral character, and

(3) That he has been actively engaged in the practice of Engineering for at least six years, in the employ or under the supervision, direction and tuition of one or more practicing Engineers. Each complete year as a student in an engineering school of recognized reputation or employed in the military service of the United States or its Allies during the present war, shall be credited as one year of practice.

(4) That, during two years of such period of six years, he has been in active, responsible charge of engineering work. Responsible charge shall be held to mean the actual supervision and direction of engineering work requiring the exercise of initiative, judgment and independent decision, and may be performed in the capacity of either principal or assistant.

(5) The State Board of Engineer Examiners shall verify the statements of the applicant, so far as practicable, and shall mail to each licensed engineer and to each employer or reference given by the applicant a copy of the statement pertaining to his experience. In not less than 60 nor more than 120 days, the application for license shall be either approved or denied, and final action taken thereon.

Sec. 11. All examinations shall be conducted in accordance with the provisions of this act, in such a manner as the Board may deem best suited to the determination of fitness of candidates for a license. The Board shall examine each candidate in that branch of engineering in which he is proficient, as set forth in his application. The Board shall have the authority to summon any engineer holding a license under the provisions of this act to assist in preparing for and conducting examinations of candidates; and such engineer shall be entitled to remuneration for services at not to exceed ten dollars ($10.00) per day in addition to necessary expenses.

The Board shall have the power to limit any license to the practice of surveying, according to the qualifications shown by the applicant upon examination.

Sec. 12. Upon the evidence of the official record that an applicant has successfully passed the examination, the Board shall issue to him a license to practice engineering upon the payment of an additional fee of five dollars ($5.00). Any person who shall, by affidavit or other proof, show to the satisfaction of the Board that he is a legal resident of this State, and was engaged in the practice of engineering at the time of the taking effect of this Act, or prior to his entering into the military or other service of the United States or its Allies, or in the service of the American Red Cross, or other similar war work during the present war, shall be entitled to a license without examination upon the payment of fifteen dollars ($15.00), provided, however, that such application be made within one year after the taking of this Act, or after the return to civil life of any person now in the service of the United States or its Allies or in the service of the American Red Cross or other similar branch of work during the present war.

Sec. 13. All licenses shall be signed by the president and secretary of the Board, under its seal. Every license granted shall be registered by the secretary of the Board.

Sec. 14. Every licensed engineer shall have a seal, the impression of which must contain his name, place of business, and the words, "Licensed Engineer," "State of Colorado," with which he shall stamp all drawings, specifications and reports issued by him for use in this State.

Sec. 15. No maps, plans, designs, reports, statements or filings to be certified or approved by an engineer shall be accepted or filed by any State official unless the certificate of approval is executed by and bears the seal of a person duly licensed in accordance with the provisions of this Act.

Sec. 16. The Board shall have the power to inquire, at any time, into the identity of any person claiming to be a licensed engineer, and may revoke the license of the practitioner by a four-fifths vote in any of the following cases:

(a) If a practitioner of engineering is guilty of any fraud or deceit in his practice or is guilty of any fraud or deceit by which he was granted a license to practice.

(b) If a practitioner of engineering is incompetent.

Proceedings for revocation of license shall be begun by filing with the secretary of the Board written charges against the accused. The Board shall designate a time and place for a hearing, and shall notify the accused of its action and furnish him with a copy of the charges. The accused shall have the right to appear personally or by counsel, to cross-examine witnesses or to produce witnesses in his defense. The Board may summon witnesses and administer oaths in proceedings for revocation of license.

Sec 17. Any person who, not being then lawfully authorized to practice engineering within this State, according to the provisions of this Act, shall attempt to practice or shall so practice for hire, and any person who shall, in connection with his name, use any designation tending to imply that he is a licensed engineer, within the meaning of this Act, and any person who shall violate any other provision of this Act, shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be punished by a fine of not more than five hundred dollars ($500.00) or by imprisonment in the county jail for not more than six months, or both.

Sec. 18. Each licensed engineer desiring to continue the practice of engineering under this Act shall pay an annual license fee of five dollars ($5.00). Upon the payment of such fee the secretary of the Board shall issue a certificate of renewal of the license of any licensed engineer for one year beginning January 1st and ending December 31st. All licenses issued under the provisions of this Act and on which the annual license fee has not been paid prior to the first day of March shall be considered as cancelled, and a record to that effect shall be made on the records of the Board, and no licensed engineer whose license shall have been so cancelled shall thereafter practice as an engineer as contemplated in this Act; provided, however, that any person having once been granted a license under this Act, may, in the discretion of the Board, be granted a new license without examination at any time upon the payment of the annual license fee of five dollars ($5.00).

Sec. 19. Nothing contained in this Act shall be construed to limit the rights, privileges and duties of architects licensed to practice under the provisions of an Act as defined in "An Act to provide for the licensing of architects and regulating the practice of architecture in the State of Colorado," approved April 26, 1909, in force October 25, 1909, and all amendments thereto; provided, that nothing contained in this Act shall prevent draftsmen or other assistants of those legally practicing as licensed engineers from acting under the instruction, control or supervision of their employers or shall prevent the employment of superintendents of construction, paid by the owner, from acting, if under the control and direction of a licensed engineer.

Sec. 20. Any and all acts or parts of acts inconsistent herewith are hereby repealed. If, for any reason, any provision of this Act shall be declared unconstitutional by the Supreme Court of the State of Colorado, it shall not effect the operation of other provisions of this Act.

GEORGE STEPHEN,
President of the Senate.

ALLYN COLE,
Speaker of the House of Representatives.

[We hope that our readers will use these columns to ridicule this monstrous piece of legislation.—Ed.]

A large percentage of wells that produce petroleum also produce natural gas, but a great many gas wells do not produce petroleum. Natural gas has been used in this country since 1821, but the development of the natural gas industry, as we are familiar with it, has taken place for the most part in the last twenty years. This development has been so uniform and so devoid of sensational features that few people appreciate its present magnitude. The reader will be interested to know that natural gas to the value of $120,000,000 was marketed in the United States in 1916, a sum greater by $27,000,000 than the value of all the gold and nearly two and one-half times the value of all the silver produced in this country that year. In that year, 2,362,494 domestic consumers, in twenty States, used natural gas for heat and light, and 18,278 industrial concerns used it for fuel. At the end of that year there were 38,000 producing gas wells and 13,000,000 acres of land under the control of gas-producing companies, and what is more pertinent to our story, these companies distributed in 1916 the stupendous total of 753,000,000 cubic feet of gas.—From Du Pont Magazine.

THE SPIRIT OF LOVE.

You will find as you look back upon your life that the moments that stand out above everything else are the moments when you have done things in a spirit of love.—Henry Drummond.

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C. ERB WUENSCH, '14...Editor and Manager

Vol. IX. JUNE, 1919. No. 6.

On June 7th the election of officers of the Alumni Association for the year 1919-1920 closed. The following men were elected:

President, R. B. Paul, '02.
Vice-President, F. C. Carstarphen, '05.
Secretary, Axel E. Anderson, '04.
Treasurer, Max W. Ball, '06.
Member Executive Committee, H. C. Watson, '01.

On Friday, June 13, 1919, the new President of the Association, Mr. R. B. Paul, called a meeting of the new officers, candidates for office and retiring officers of the Association. They met at a luncheon at the Albany Hotel.

The following men were present:

R. B. Paul.	Marshal W. Draper.
A. K. McDaniel.	Theo. Benjovsky.
John G. May.	C. Erb Wuensch.
Max W. Ball.	

Ways and means of stimulating the interest of the alumni in the work of the Association and the school were discussed. It was thought that the inauguration again of a regular monthly luncheon would be an effective means to foster good spirit and make the Association a live one.

Owing to the absence of a quorum, no definite action was taken. We hope to get "the ball started" very shortly. Perhaps in the next issue of the magazine we will be able to announce definite plans. If you have any suggestions send them to the Secretary of the Association at Golden.

WANTED.

Index for Volume CV, January to June, 1918, of the Engineering and Mining Journal. Will pay reasonable price.—Library, Colorado School of Mines, Golden, Colo.

Several of our Latin-American students went to Cripple Creek in response to an invitation, to obtain work for the vacation months. Upon arriving there they were informed that Cripple Creek was a "white-man's camp" and that no foreigners were permitted to be employed. Their railroad fare was refunded them and they departed feeling very much offended at such insulting discrimination. They went to another Colorado mining camp and succeeded in finding employment.

We are glad to learn that all mining camps are not so exclusive—exclusive in their own bigotry. Of what can Americans be thinking to permit such discourtesy to Latin-Americans—Latin-Americans of the educated class—whose friendship we should use every means to gain. How indignant we should feel if we were so politely discriminated against should we seek employment in a foreign country.

We appreciate the purpose of making Cripple Creek a "white-man's camp" but it would be infinitely better if discrimination were based upon an ethical standard—one which judges men not by race, creed or earthly possessions, but by their character, their sense of duty and morals in human relations. If such a standard were adopted we fear that some of the strongest boosters for a "white Cripple Creek" would have to seek refuge in a "dirty creekly-crip."

The managers who had to perform the disagreeable task of sending these men away, did so not in response to their inner-most convictions, but to the impelling force of an undemocratic camp-tradition.

CAPABILITY EXCHANGE.

The Colorado School of Mines Capability Exchange is no longer co-operating with the Technical Employment Agencies in Denver, as was announced in the February issue. The Capability Exchange is now operating independently. With a permanent manager at Golden it was decided that the Capability Exchange could render more efficient service to its Alumni members and employers. If you need a man send to the Capability Exchange, Golden, Colo.

ALUMNI DIRECTORY.

If you want a copy of the Alumni Directory, which will give you the name, address and occupation of every alumnus of the Colorado School of Mines, send 35 cents to the Colorado School of Mines Magazine, Golden, Colo. The directory will be issued shortly after July 1st.

PERSONALS

'95.

On June 1st Mr. Clyde M. Eye sailed from Baguio, Prov. of Benguet, P. I. for San Francisco, Calif.

'96.

Wm. H. Paul, Consulting Engineer of the International Railroads of Central America, is at his permanent address, Littleton, Colo.

'97.

Frank H. Lerchen is at the Cubo Mine, Guanajuato, Guanajuato, Mexico.

Marshall D. Draper left for China, where he will conduct an exploration party for a syndicate of New Yorkers.

'01.

Geo. O. Marrs won a very important law-suit for the Agricultural Ditch and Reservoir Co., of Denver, Colo. Marrs has offices in the Century Bldg., Denver.

Hugh C. Watson is now Manager of the Newman Mining, Milling & Leasing Co., of Aspen, Colo. Watson was Manager of the Greenback Mining Co., of Leadville, until the company ceased operations last month.

'02.

G. M. Butler, Dean of the College of Mines and Engineering of the University of Arizona and Director of the Arizona Bureau of Mines, has been examining oil lands in Texas. Butler addressed the Southwestern Society of Engineers in El Paso upon his return to Tucson.

'03.

Harry J. Wolf has resigned from the Professorship of Mining at the Colorado School of Mines. He has gone to New York to join the Editorial Staff of the E. & M. J.

Augustus D. Cox is at Dome, Ariz. His offices are in the Clay Peters Bldg., Reno, Nevada.

'05.

Mr. and Mrs. A. C. Terrill announce the arrival of a ten-pound girl on February 26th. Terrill is Professor of Mining at the University of Kansas. He states that his daughter is thriving nicely and is slowly but surely taking possession of their home.

'07.

Albert G. Wolf is in charge of a property at Gulf, Matagorda County, Texas, adjacent to the Texas Gulf Sulphur Co., and owned by New York men, where he is drilling for sulphur.

'10.

D. Ford McCormick has just returned to Minas de Matahambre, Rio del Pinar, Cuba, after a visit to the U. S.

Dana W. Leeke has resigned his position with the Seoul Mining Co., at Tul Mi Chung, Nantei, Chosen. Leeke will spend about three months in Japan in behalf of some professional work before returning to his home in Upland, Calif.

G. S. McKay left Mazatlan, Mexico, and is now at Townsend, Montana.

'11.

S. J. Clausen Jr. returned from Salvador, C. A., and is temporarily at 1861 W. 10th Street, Los Angeles, Calif.

W. F. Koch has returned from France and is back in his old position with the Hercules Powder Co., 1020 Kearns Bldg., Salt Lake City, Utah. Koch was Assistant Instructor in the Army Engineer School and had charge of demolition work. He held the grade of Master Engineer.

Mr. and Mrs. W. W. Barnett had a little baby girl visit them last October at their home in Tul Mi Chung, Chosen. Barnett is Assayer for the Seoul Mining Co.

'12.

Ross R. May has resigned his position with the Empire Zinc Co. and is now Engineer for the Potomac Copper Co., at Potomac, Montana.

Wilfred Fullerton is teaching Chemistry at the A. E. F. University, at Beaune, France.

'13.

George Wilfley was married to Mrs. Helen Kunz on Decoration Day, in Denver, Colo.

Mr. and Mrs. John F. Meyers, of Canon City, Colo., announce the arrival of Lorin Solon Meyers on May 31st. Meyers is Flotation Engineer for the Empire Zinc Co.

Arthur C. Swanson is in Golden on a short visit enroute to Seattle, Wash.

George J. Arfsten has returned from France and is temporarily at his home address, 3705 Wolff St., Denver, Colo.

'14.

F. S. McNicholas has returned from Cuba. He is at his home, Sun City, Kansas, on a short vacation.

John W. Turner is scouting in the Texas Oil Fields.

Joe "Tuffie" Woolf has written the following anecdote to depict the way things are done in Korea:

"A lady friend was driving her machine down one of the streets in Seoul at about a two-mile gait. An old Korean was walking down the middle of the street, beside the car. She thought the Korean surely knew the car was beside him, so at the corner she got a little ahead and attempted to turn. The Korean didn't stop, however, and walked directly into the car. The shock knocked him down. He got up screaming 'Igoing' (that's a Korean swear-word), and acted as though he had broken his wrist. A Japanese policeman, with his sword and all the other trimmings, rushed upon the scene. He started in to give the lady a brow-beating, but when she acted very repentant and offered to take the old coolie to the hospital, or any place he wanted to go, he was at a loss for words. Finally, he reprimanded the lady and told her how to drive her car in the future. He said: 'Next time you want to turn corner, you must stop before corner, get out, take a look all around and nobody near, all right, get in and go around corner.'"

'15.

Chas. F. Haselton has returned to his home, 550 Prospect Ave., Hartford, Conn., after a year's service in France.

'16.

Wayne A. Harrod was a visitor in Golden recently while en route to Fort Warden, Seattle, Wash., to be discharged from the service. He was a lieutenant in the 50th Heavy Artillery.

Lieut. Frank E. Briber has returned from France and is at present suffering with a broken leg, in which infection has developed, at the Walter Reed Hospital, Washington, D. C.

Harry M. Wilson is with the New Cornelia Copper Co., at Ajo, Ariz.

Mr. and Mrs. R. M. Fullaway announce the birth of Richard Mearle Jr. on May 9, 1919. Fullaway is now with the Gila Copper Mining Co., at Christmas, Ariz.

Sidney W. Mewhirter is at Morenci, Ariz.

'18.

Ensign Charles Albi has returned to his home, 1650 Vine Street, Denver, Colo., after over a year's active service abroad. He was stationed at Bordeaux.

L. C. Chiang is at the University of California doing chemical research work. His address is 2206 Atherton St., Berkeley, Calif. Chiang just completed some investigation relative to low-grade manganese ores and their treatment by the flotation and the electro-chemical processes.

'19.

W. A. Conley and Guy Miller have joined the staff of the Roxana Petroleum Co. as Asst. Geologists, with headquarters at Cheyenne, Wyo.

Rene J. Mechin is Engineer for the Nacozari Copper Co., Nacozari, Sonora, Mexico.

O. H. Metzger is surveying for Ed Millard & Son, a prominent engineering firm of Ely, Nevada.

Blair Burwell has gone to the Diamond Fields of Belgian-Congo, West Africa.

L. D. Mulford is at Telluride, Colo.

T. B. Romine has gone to Angangueo, Michocan, Mexico, to accept the position of Chief Sampler and Ass't Engineer with the A. S. & R. Co.

EX-MINES NOTES.

Ex-'11.

Chas. Hemberger won the Croix de Guerre for gallantry under fire.

Hal Watkins has returned to his home in Golden after several months' service in France.

Ex-'12.

Jefferson Davis, of 1008 Hobart Bldg., San Francisco, Calif., was a visitor in Golden recently.

MISCELLANEOUS.

Dr. Victor C. Alderson has returned to Golden from a short professional trip to Boston.

Prof. F. W. Traphagen, of the South Dakota School of Mines, has returned to his home in Golden for the summer.

Prof. F. E. E. Germann, who resigned from the School of Mines Faculty, has been appointed Professor of Physical Chemistry at the University of Colorado. He will also have charge of the department of Chemical Research.

John P. Bonardi has returned to the U. S. Bureau of Mines at Golden, Colo., after completing three months research work at the Seattle Station.

Ralph Glaze, the new School of Mines Coach, has arrived in Golden.

SCHOOL NEWS.

On Friday, May 23rd, the forty-fifth annual commencement exercises were held. Mr. Edwin S. Church, President of the Wellman-Seaver-Morgan Co., of Cleveland, Ohio, delivered the address.

The graduates were:

Blair Burwell, Denver Colo.; Mifflin Morrison Butler, Denver, Colo.; Yuan Chen Chao, Chen-hing, Kansu, China; William Olwyn Charles, Golden, Colo.; William Albert Conley, Golden, Colo.; Ronald Scott Coulter, Denver, Colo.; Rene Jean Mechin, St. Louis, Mo.; Otto Henry Metzger, Meeker, Colo.; Guy Edwin Miller, Canon City, Colo.; Loren Dallas Mulford, Golden, Colo.; Russell Johnston Parker, Denver, Colo.; George Henry Roll, Ellsworth, Minn.; Thomas Beeson Romine, Walla Walla, Wash.

Thomas B. Romine won the gold medal presented by Prof. Harry J. Wolf for the highest scholarship. Guy E. Miller received the silver loving cup, which was given by Prof. Victor Ziegler, for all-around prominence in school activities, athletics and high scholarship.

Summer school will commence on Monday, July 14th, and will last until August 23rd. Practically all subjects that are taught during the regular school session will be given. This is a splendid opportunity to make up entrance deficiencies or irregularities.

Mr. Hal W. Hardinge, of the Hardinge Conical Mill Co., presented the school with a 3-foot Hardinge Mill for use in its Experimental Plant. This will prove a very useful gift, because the Testing Plant is badly in need of a fine-grinding machine.

Prof. H. J. Wolf, of the Mining Department, has resigned in order to become Associate Editor of the Engineering and Mining Journal, with headquarters in New York City.

Mr. H. G. Schneider, Instructor in the Department of Geology and Mineralogy, has resigned.

COURSES IN OIL-SHALE CHEMISTRY.

Three new courses will be offered next year in the chemistry department. The first, called the "Chemistry of the Hydrocarbons," will consist of eighteen lectures on the organic chemistry related to the compounds of hydrogen with carbon. A study will be made of the preparation, physical properties, chemical conduct and uses of the compounds obtained from natural gas, coal, petroleum and oil-shale. One object of this course is to serve as a preparation for Course XVI on "The Analysis of Oil-Shale" and as a preparation for the new courses on "Petroleums." Another object is to give a knowledge of those parts of organic chemistry which are essential in the gas, coke, petroleum and oil-shale industries.

The second course will consist of eighteen lectures on "Petroleum." A study will be made of the chemistry and technology of the different refining methods and of the utilization of the products obtained from crude oil. While the engineering features are to be emphasized, attention will also be given to the analytical methods used in control work and in the determination of the character and quality of petroleum and its products.

The third new course will be laboratory work with petroleum and its distillates. Crude oil will be distilled and purified in order to determine the yield and quality of petroleum, ether, gasoline, kerosene, lubricating oil and coke. The commercial value of the distillates will be determined by tests for specific gravity, flash-point, fire test, viscosity, amount of sulphur, etc. Experience will be given in the analytical methods used in control work and in the valuation of petroleum products. A new laboratory will be equipped for this course.

C. W. BOTKIN,
Associate Professor of Chemistry.

NEW COURSES IN GEOLOGY.

The Geology Department will offer the following new courses next fall:

Geological Surveying. A complete course to enable the student to become familiar with practical field methods of geological mapping.

Map Interpretation. The purpose of this course will be to enable the student to use topographic maps intelligently. Students will obtain practice by interpreting the excellent topographic maps which are issued by the U. S. G. S.

Oil Field Development. This course should prove of especial value to students interested in oil geology. The students will be taught how to make use of this knowledge of geology in discovering and developing new oil fields.

Geological Seminar. The purpose of this course is to give the student practice in delivering a discourse on a geological subject.

Geological Research. The student will be taught the use of all the scientific methods available in making a geological investigation.

A NEW COURSE IN UNIFIED MATHEMATICS.

In the coming school year, courses in algebra, trigonometry and analytical geometry will be replaced by a course in Unified Mathematics which will combine the three courses above mentioned in such a manner as will bring out the essential harmony between the two main branches of mathematics, namely: analysis and geometry. Many practical problems will be drawn from subjects more or less familiar to the students and in which the student of engineering is vitally interested, such as: physics, mechanics, the architectural uses of the cross-section, statistics and many others. In fact, the object of the course will be such that a student who has in any way mastered the material presented will at the same time have acquired a real appreciation of the mathematical problems which confront the engineer and will also find that his mathematics constitute a real tool with which to attack and solve these problems. T. O. WALTON.
Professor of Mathematics.

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Electric Smelting with Special Reference to Canadian Conditions*

By Robert M. Keeney, '10.†

Favorable Conditions in Canada.

In one respect Canada is in a more favorable location for the electric smelting of ores than any other country where hydro-electric power can be developed cheaply enough to permit competition of electric with combustion smelting. A greater variety and larger quantity of ores, which can be smelted electrically, are available in Canada than in Norway, Sweden or France; the only countries where large blocks of very cheap power are obtainable for electric furnace operations. In Canada there are found ores of iron, chromium, molybdenum, copper, nickel, lead and zinc, which, under conditions existing in some cases and proper application of technical skill, can be advantageously smelted in the electric furnace. In Norway, Sweden and France, with the exception of iron ore, if electric smelting is applied on a large scale the ores must be imported, whereas in Canada, copper, nickel, lead and zinc ores are found in large quantities, and open a new field for electric smelting.

Sites for hydro-electric power are available for large developments in Canada at a cost only slightly greater than the cost of power in Norway and Sweden. Power in Norway and Sweden costs from $8 to $12 per horse-power-year as compared with $10 to $15 per horse-power-year in Canada. With power developed by an electric smelting company itself, instead of purchased from a power company, the lower figure of $10 per horse-power-year would be possible in many instances. This course is followed by most large electro-metallurgical industries in Norway. For smelting of non-ferrous ores, a new field for the electric furnace, the western coast of Canada offers great opportunities. Under suitable conditions electric smelting should be able to compete commercially with combustion smelting in British Columbia.

Requisites for Sucessful Smelting Operations.

The commercial success of an electric smelting industry, in which the basic process is technically sound, may depend largely upon the following factors in the order of their importance: (1) the financial backing of the company; (2) the market for the product; (3) the cost of electric power; (4) freight rates; (5) cost of ore and raw materials; (6) labor conditions. Of these factors financial backing and market are by far the most important after the plant is built, because the other factors are invariably taken care of when deciding whether or not to start a new industry. In the present period of reconstruction, financial strength is of greatest importance. It is essential under present conditions for a concern to be in a financial condition to either shut its plant down or carry a heavy stock of product while waiting for the market to develop. Because of the fluctuating market conditions in the sale of electric-furnace products, and also because of the necessity of keeping the plant in continuous operation in order to maintain a low power-rate, a large operating capital is more essential in electric furnace smelting on tonnage products than in many other industries. Except with unusual luck in falling into a rising market, electro-metallurgical operations on a "shoe-string" basis invariably result in failure, regardless of technical success and cost of production. This applies to Canadian conditions as well as elsewhere where it is necessary to export a large part of the production.

Favorable Sites.

Canadian water-power sites are favorably situated with respect to a market for electric-furnace products. Those of Ontario and Quebec are close to the center of the population of Canada, and close to the manufacturing centers of the United States. They are also favorably situated for exporting by water through the St. Lawrence River.

The greater part of the product of electric smelting, in this locality, must of necessity find a market by export to the United States and Canada. Also, due to the ores available in this district, with the exception of electric smelting of nickel ores, electric smelting must be confined to those electro-metallurgical processes that are recognized as successful, technically and commercially, under favorable conditions.

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*Paper presented at the March, 1919, meeting of the Canadian Mining Institute.

†Director of Experimental Ore Dressing and Metallurgical Plant, Colorado School of Mines.

The other district in Canada where there are great possibilities of electric smelting developments is British Columbia. With the exception of electric smelting of iron ore, developments there must be along the line of smelting copper, lead and zinc ores, and gold and silves ores, using low-grade copper ores as a collecting agent. Due to technical difficulties encountered in electric zinc smelting, the process has not gained commercial success, in spite of the high price of zinc, during the war. It seems that the lead-zinc ores of British Columbia can be best treated by a wet electrolytic process. With cheap water power electric smelting of copper, lead, gold and silver ores has a future, particularly for small properties in isolated districts where coal and coke are expensive. If labor costs in coal mining continue to increase, electric smelting may even compete commercially with combustion processes. The technical difficulties of electric smelting of these ores are not great. After a short railroad haul, and in many cases without railroad transportation, products of electric smelting from British Columbia would be open to the world market by ocean transportation.

Electric Smelting of Iron Ores.

The electric smelting of iron ore is advantageous only in localities where fuels suited to blast furnace reduction are expensive and electric power is cheap. Iron ore exists in Canada under such conditions, particularly in British Columbia. Conditions in Canada are more favorable to the electric smelting of iron ore than those existing in any country, with the exception of Norway and Sweden. It has been customary to consider electric smelting of iron ore from the viewpoint of using charcoal or coke as the only available reducing agents, charcoal being preferred. The use of coke has not been successful in the Trolhattan furnace, the electric smelting furnace most widely used in Sweden. In this furnace the ore is charged through a shaft and the gases drawn off and circulated back through the furnace. For the shaft furnace charcoal is believed by many metallurgists to be the only successful fuel, coke being considered a failure due to its high electrical conductivity, which results in a low power-factor in the furnace. Coke, however, is being successfully used as a reducing agent at Nottodden, Norway, in a furnace of the Tinfos type. In the Tinfos furnaces, which are single phase, all of the current passes through the bottom. This furnace has charging shafts, but no attempt is made to circulate the gases. In the opinion of the writer, the Tinfos furnace is successfully operating with coke, because of the electrical conditions of the conducting charge. The slag and metal lie between the two electrodes, and all of the current passes through them. Hence, the electrical conditions stay much more uniform than in the Trolhattan furnace where there is no bottom electrical connection, and where the current passes between the three electrodes in a horizontal plane. In brief, the failure of the Trolhattan furnace, when using coke instead of charcoal, is not due to its having a shaft, but because the current passes between the electrodes in a horizontal plane, thus giving, if at any time a large amount of coke enters this zone, a chance for excessively high conductivity. This is very noticeable in smelting manganese ore in a three-phase furnace without a shaft, where there are three electrodes and no bottom connection. When coke is used as a reducing agent, due to the high conductivity of the charge, the electrodes rise to the top of the furnace, making it impossible to operate commercially.

The conditions which are thus necessary for the use of coke as a reducing agent, mean its elimination in large electric smelting furnaces. Large furnaces with a bottom electrical connection are not satisfactory in their construction, or operation, because of the difficulties involved in bringing heavy currents to the furnace, and the danger of metal going through the bottom.

Reducing Agents.

With coke eliminated, under existing practice in electric smelting of iron ore, only one reducing agent is available in Canada—charcoal. Although large forests are available for the production of charcoal in Canada, it is an expensive reducing agent in any furnace.

However, all grades of coal from lignite to anthracite have proven to be satisfactory reducing agents in the manufacture of ferro-manganese in the electric furnace. For this purpose lignite and bituminous are preferable because of the tendency of anthracite to form calcium carbide in the presence of the large excess of lime necessary in smelting manganese ores.

Coal should prove to be as satisfactory a reducing agent as charcoal in the electric smelting of iron ore, if the proper type of furnace is used. Coal would not be satisfactory in a shaft furnace, because the charge would pack so closely as to prevent the passage of the gas up the stack. With coal the furnace should have a partial roof, possibly charging chutes, and horizontal flues in the furnace walls for drawing off the unburned gases before they pass out through the charge. These gases have a high calorific power and should be used under boilers, in an open hearth, or in a lime kiln. Crediting the furnace with the heat obtained from the gas, such a furnace will show as high a thermal efficiency as the shaft furnace, and result in fewer operating difficulties because of its greater simplicity. Even if the gases are not burned for a useful purpose, this type of furnace has many advantages over the shaft furnace, because of its simplicity.

Successful use of coal as a reducing agent in the electric smelting of Canadian iron ores would broaden the field considerably. In electric smelting manganese ore all grades of coal have been used as a reducing agent—lignite, bituminous and anthracite. In the writer's experience lignite is the most satisfactory, as it does not tend to form carbides to the extent of the bituminous and anthracite.

A Colorado lignite coal of the following composition proved the most satisfactory:

	Percent
Fixed carbon	44.84
Volatile	36.42
Ash	4.90
Moisture	13.84
Sulphur	0.26

Colorado anthracite coal of the following composition was tried:

	Percent
Fixed carbon	84.9
Volatile	4.78
Ash	9.69
Moisture	0.63
Sulphur	0.71
Phosphorus	0.011

In addition to formation of carbides in smelting with anthracite, the manganese loss was 10 percent higher, and the power consumption greater.

Future of Electric Iron Smelting.

The future of electric smelting of iron ore in Canada is a question of cost of production in the electric furnace versus cost of production in the blast furnace. It is not a question of saving fuel as in Sweden. With the proximity of eastern Canada to large centers of pig iron production in the United States, electric furnace smelting of pig iron in eastern Canada from iron ore does not seem to have much future. In smelting titaniferous ores it probably can smelt as cheaply as the blast furnace. On the other hand, in western Canada electric smelting of iron ores should be cheaper than blast furnace smelting. Power is cheap. Coke is expensive and hard to obtain. By the use of coal or charcoal, as a reducing agent, electric furnace pig iron should be made more cheaply than blast furnace pig iron. With the high price of pig iron on the Pacific Coast of Canada and the United States, there is a possibility of developing a large electric furnace pig iron and steel industry; large by comparison to present size of the electric furnace iron and steel industry, but small in proportion to the blast furnace production of pig iron and open hearth production of steel.

Of Copper Ores.

Although no copper ores are being treated commercially in the electric furnace, so far as the writer is aware, experimental results show that it is feasible, both metallurgically and commercially, under suitable local conditions. British Columbia, with its cheap water power and expensive coke, is a favorable field for the development of electric smelting of copper ores, and the writer believes that in that part of Canada there exists or will exist properties where electric smelting will prove cheaper than combustion smelting or shipping the ores or concentrates.

Existing experimentation indicates the logical path of the development of electric copper smelting to be a metallurgical process similar to reverberatory copper smelting, in which electrical heating is substituted for combustion heating with coal as a fuel. In the case of a heavy sulphide ore this involves roasting in a roaster of the Wedge or Herreshoff type, followed by electric smelting of the calcine, and production of matte and slag. With a lean sulphide ore or an oxide ore direct electric smelting is possible. Such a process does not involve a complicated type of electric furnace, and with a modern 3,000 kilowatt furnace, modified to suit the conditions of the process, a capacity of 125 to 150 tons of ore per twenty-four hours should be attained, at a cost comparable with combustion smelting if cheap power is available.

A small amount of experimental work has been done in electric smelting of iron sulphide ores, by the use of air as in the blast furnace, but such a process involves a complicated furnace design, and might result in excessive electrode consumption. It has not been developed experimentally to any extent, and its application commercially is problematical.

The electric smelting of copper ores is nothing more than the substitution of electric heat for the heat derived from the combustion of carbon. Inasmuch as the carbon which is used either in the reverberatory furnace or in the blast furnace plays no important part in the reactions which take place in these furnaces, there is no reason metallurgically why electric heat may not be substituted for the heat derived from the combustion of carbon. In fact, in some cases the reactions take place to better advantage in the neutral atmosphere of the electric furnace than in the reducing or partly reducing atmosphere of the combustion furnace. Therefore, the practicability of using the electric furnace for smelting copper ores depends largely on the relative cost of fuel and power. The use of the electric furnace cannot be advocated logically as a competitor of the combustion furnace, but it should be considered as a substitute for it in those localities where it is not advisable, because of the high cost of fuel, to use the ordinary smelting processes.

Of Nickel Ores.

Electric smelting of nickel ore has been successful experimentally, but it has not been used on a large scale commercially. Most of the experimental work has been along the line of direct reduction of raw ore or roasted ore to a pig ferro-nickel, involving the recovery of nickel, iron and copper in the pig metal. With power at $10 to $15 per horse-power-year the nickel ores of Canada can be smelted in the electric furnace as cheaply as in the blast furnace to produce pig ferro-nickel. It is probable that if the electric furnace and electrical power equipment had been in the present stage of development when the metallurgy of Canadian nickel ores was developed, the process would have been along this line instead of the present process.

However, the fact remains that the consumer of nickel prefers his product in the fine form now produced, and not as a ferro-nickel, and it is probable that a considerable period of time will elapse before this prejudice can be overcome. Also the same may be said in regard to the copper in the steel produced from pig ferro-nickel. The steel manufacturer and consumer will be very slow in giving up the idea that copper in small quantity is detrimental to steel, regardless of research work proving it is a benefit.

With power at $10 to $15 per horse-power-year and coke at $7 per ton, electric smelting for the production of nickel-copper matte can compete with the blast furnace or reverberatory furnace. It can be used in a manner similar to the processes mentioned in discussing electric smelting of copper ores. Due to existing prejudices to the use of pig ferro-nickel, and to the presence of copper in steel, conditions seem to be more favorable for electric smelting of nickel ores in Canada to produce a matte, rather than to produce pig ferro-nickel.

Of Lead Ores.

The smelting of ordinary lead ores in the electric furnace has never been attempted commercially or on a large experimental scale, largely because of the ease and cheapness of smelting by combustion processes. The rapid development of large reverberatory resistance furnaces for smelting metals and heating steel billets, opens the field of low temperature smelting processes to the electric furnace. At the present time electric furnace smelting of lead ores is simply speculative.

Of Zinc Ores.

While the electric smelting of zinc ores is more advanced than that of copper ores, it has not yet proved a commercial, or, in fact, a technical success. With the cheap power existing in western Canada there is an excellent field for electric zinc smelting if the great technical difficulty encountered in electric zinc smelting, blue powder formation, could be solved. As this problem is as yet unsolved, and there appears to be no immediate solution in sight, electric zinc smelting will probably be put in the background by electrolytic zinc production for a period of years.

Conclusions.

Conditions for electric smelting in Canada are more favorable than any country in the world where there has been extensive mining development, with the exception of Norway and Sweden. But, in general, aside from the smelting of iron ores, the manufacture of aluminum and the production of ferro-alloys, the electric smelting of ores is still in the experimental stage. It will probably never replace existing processes where the conditions are favorable to the latter, except insofar as it may permit development of a process which may be more efficient than an existing process. However, it is not necessary to consider the electric furnace as a competitor of the combustion furnace, but as a means of affording the metallurgist a furnace which will enable him to treat certain ores and to work out certain processes in a more advantageous manner than it is possible to do in the combustion furnace, or to treat ores in certain districts where, owing to local conditions of cheap power and expensive coal and coke, combustion furnaces are not practicable.

Statistical Treatise on Petroleum

By Fred A. Lichtenheld, '20.

PART II.

(Concluded from June Issue.)

Drilling Methods.

Various methods of drilling have been developed to suit particular needs. These are all modifications of two general systems and used today in North America. These are:

1. The standard or churn-drill system.
2. The rotary system.

The two systems are seldom used side by side in the same field, except in some districts in California. Modifications are developed to meet different conditions as new fields are drilled.

Standard or Cable Drilling System.

This system is often called the percussion or American cable system, and consists essentially of a heavy steel bit attached to a manila or wire cable, which is raised and dropped by means of a walking-beam extending over the hole.

It is adapted for drilling into hard formations or those sufficiently consolidated to permit the sides of the hole to "stand up," so that drilling may be carried on until it is advisable to case off the water-bearing stratum. The paleozoic rocks found in the Appalachian, Lima—Indiana, Illinois, and Mid-Continent fields of the United States are drilled by this method.

The Rotary System.

This system consists of a drilling stem, to which is attached, at the bottom, the bit or cutting tool.

Circulating water is pumped through these rods to remove the cuttings, and thus keep the bit working efficiently in the fresh rock.

The rods are rotated by means of a geared turn-table, provided with grips, driven by power of some sort. The power used is generally a gas or steam engine, or an electric motor.

Where there are alternating hard and soft strata, although the cable tools might drill the former in less time than by the rotary method, the danger of accidents due to caves in the soft ground more than offsets the speed in drilling.

Combination System.

In California fields the two systems are sometimes combined, one part of the hole being drilled by the rotary, the other part is drilled by cable tools. This combination method is particularly adapted to conditions such as those in Mexico, where the upper part of the hole is drilled entirely through soft marts and shales with occasional limestone shell; the rest of the hole is drilled through hard limestones and shales. In California the oil sands are generally drilled through by the cable tools, in order that it may be better and properly managed.

The relative percentage of drilling methods of various oil fields are as follows:

Standard method.....55 percent
Rotary method.......23 percent
Combination method..22 percent

Comparison of the advantages and disadvantages of the two drilling systems:

Standard System.

Advantages:

1. Less first cost of tools and rig.
2. Lower labor cost per day.
3. Less water necessary.
4. Can drill in the hardest rock.
5. Gives more information as to the formations passed through.
6. Less cost per foot for relatively shallow wells.

Disadvantages:

1. Longer drilling time.
2. Much slower when under-reaming is made necessary by caving.
3. Danger of delays and fishing-tool troubles in soft strata.
4. Greater cost per foot for moderately deep wells.
5. More casing necessary to handle caves and water sands.
6. Liability of getting crocket holes in soft formations.

Rotary System.

Advantages:

1. Faster drilling in soft strata.
2. Less trouble from caving and water sands.
3. Less casing used in soft formations with water and gas sands.
4. Straighter hole in deep drilling soft formations.
5. Can drill in alterating hard and soft formations.
6. Can carry a large hole deeper.
7. When "drilling in" easier to control high pressure and prevent blow-outs.

Disadvantages:

1. Very slow in hard strata.
2. Greater daily labor cost.
3. Greater cost per foot for shallow wells.

Cost of Drilling Wells.

Locality	Standard Method	Canadian Method
United States		
Gaines, Pa.	$0.65 per foot	....
*Summerland, Calif.	0.85 per foot	....
Northern Mississippi Valley.	0.75 per foot	....
Texas, Beaumont Fields....	4.00 per foot	....
Caddo, Louisiana	$12,000 average per well	....
Mid-Continent Field	$0.70 to $2.00	....
Canada		
Brant County	....	$800 a well
Ontario	....	$160 to $500 a well
Haldimand County	$700 a well	....
Simcoe	$1.25 per foot	....
Northern Alberta	....	$25,000 a well
Central Alberta	$9.50 to $10 per foot	....
Roumania	....	$8 casing
Burma	....	$3 casing

* The cost of drilling wells in California differs greatly in various fields, and even in different parts of a single field.

The following table illustrates the approximate drilling costs per foot for different depths, and fields of California, equipped for pumping.

Costs per Foot. Standard Rotary in Midway

	1,000 Ft. Standard			2,000 Ft. Standard			3,000 Ft. Standard		
	Labor	Material	Total	Labor	Material	Total	Labor	Material	Total
Coalinga	$2.02	$9.68	$11.70	$2.34	$9.15	$11.49	$1.90	$9.88	$11.08
Kern River	1.90	5.00	6.90	...	...	....	...	...	....
Midway, Sunset—									
*McKittrick	1.16	6.40	7.56	...	...	....	2.48	8.38	10.86
Santa Maria	...	...	....	...	...	....	1.69	2.72	4.41
Los Angeles & Orange	...	...	....	0.78	3.06	3.48	2.22	2.50	9.72

Coalinga Field, Standard Tools

	1330 Ft.	2083 Ft.	2485 Ft.	2830 Ft.
Total cost per foot	$11.70	$11.49	$10.28	$11.08
Casing per foot	4.00	4.11	4.21	4.80
Labor per foot	2.06	2.34	1.85	1.90
Drilling, labor	1.56	2.02	1.60	1.68
Actual time worked, spudding to pumping..	80 days	160 days	149 days	175 days
Feet per day	16.6	13.0	16.7	16.2

Drilling crew (12 hours), 1 driller	$7.00
Drilling crew (12 hours), 1 tool dresser	4.50
Tubing gangs (12 hours), foreman	4.00
Tubing gangs (12 hours), laborers	3.25

4. Does not show up smaller oil and gas "pays" and important reservoirs may be passed through in prospecting.

6. More water necessary, a drawback in arid regions.

Comparative Cost and Drilling Time.

In very few fields can any comparison of cost be properly made between the standard and the rotary types of drilling. While average drilling costs may be given for a certain district, individual wells in such districts may cost from 50 to 100 percent higher, because of accidents or unusual underground conditions.

The following tables show the average drilling costs taken from the records of a large number of wells of the different countries:

The General Distribution of Petroleum in Foreign Countries.

Although the United States produces about 60 percent of the world's petroleum, there are some very important foreign producers of which Russia, Dutch East Indies, Galacia, Mexico, Roumania, Canada, Japan, India, Peru, Japan and Formosa, Germany and Egypt are the most important. Russia has been the United States' rival in petroleum exports for a great many years. She has been steadily producing about 60 to 70 million barrels each year for the last 20 years.

Mexico now ranks second in the petroleum industry. The great investments in Mexican oil properties by the large companies of the United States give promise of much activity for the future. It is one of the coming oil-producing fields of the world. Next to Mexico the South American countries, especially Venezuela, Peru and Argentina, have promising futures. Because of the great war in Europe new developments were not undertaken.

The Dutch East Indies is another very important field. It has been producing since 1893, and gradually increasing its production, until now it is about 13 million barrels. The oil is high grade and commands a high price. A petroleum refinery was erected in 1917 by the Curacaoshe Petroleum Moolschoppig, a Dutch corporation, in the inner harbor of Curacao. This will refine the crude oil from the Maracoibo fields. The plant was constructed by American contractors, and most of the skilled labor is American.

Most of the petroleum comes from Tertiary rocks of shallow depths. The oil occurs in anticlines, or domes, having a steep dip like those of Wyoming.

Foreign Countries.

Other countries which yield large supplies of oil are Russia (Baku), Roumania, Galicia (Austria-Hungary), East Indies (Borneo, Java and Sumatra), Mexico, Burma, Peru, Japan, Germany, and Egypt. Small but very promising fields are in operation in Italy and the South American Republics. The most important will be discussed in a general way.

Russia—Baku Oil Fields.

The oil fields of Baku attained worldwide fame in consequence of the prodigious yields of the individual wells at a time when such great outputs were unknown.

Two of the world's greatest oil fields lie within a few miles of the old Tartar city of Baku. The Balakhany-Sobooutchy-Romany fields occupy an area of about 2,640 acres on a plateau a few miles from the Caspian Sea; the Bibi-Erbat field is situated in a secluded bay on the coast line of the Caspian Sea, about two miles south of Baku, and cover an area of 1,000 acres.

Great difficulty is encountered in drilling wells in the soft Tertiary clays and sands from which the oil is obtained. Wells of a depth of 2,000 to 2,500 feet cost $50,000 or more to complete and require a starting diameter of 36 to 40 inches to insure the required depth being attained with a workable size.

In 1897 the Russian government commenced the construction of an 8-inch pipe-line from Baku to Batoum on the Black Sea. It was completed in 1905. It had a capacity of 7,500,000 barrels of oil a year.

Grosny Oil Field.

The second field of importance is situated on the main railway line to the Caucasus mountains, and it is conveniently located for export.

The strata are much more compact and less liable to cave than those of Baku, enabling wells to be sunk much quicker and more cheaply. The structure also differs from that of Baku in that the oil belt is narrow and found along the flanks of a ridge, rising from the valley of Tirek. On the neighboring parallel range of Sunja there are excellent indications of oil, which so far have not been prospected, but which will certainly be developed into important oil fields.

Other Oil Fields of Russia Are:

Ural, Caspian, of which climatic conditions are a hindrance to its development; Chelekean, which produces a petroleum rich in paraffin wax; Maikop, and Central Asiatic.

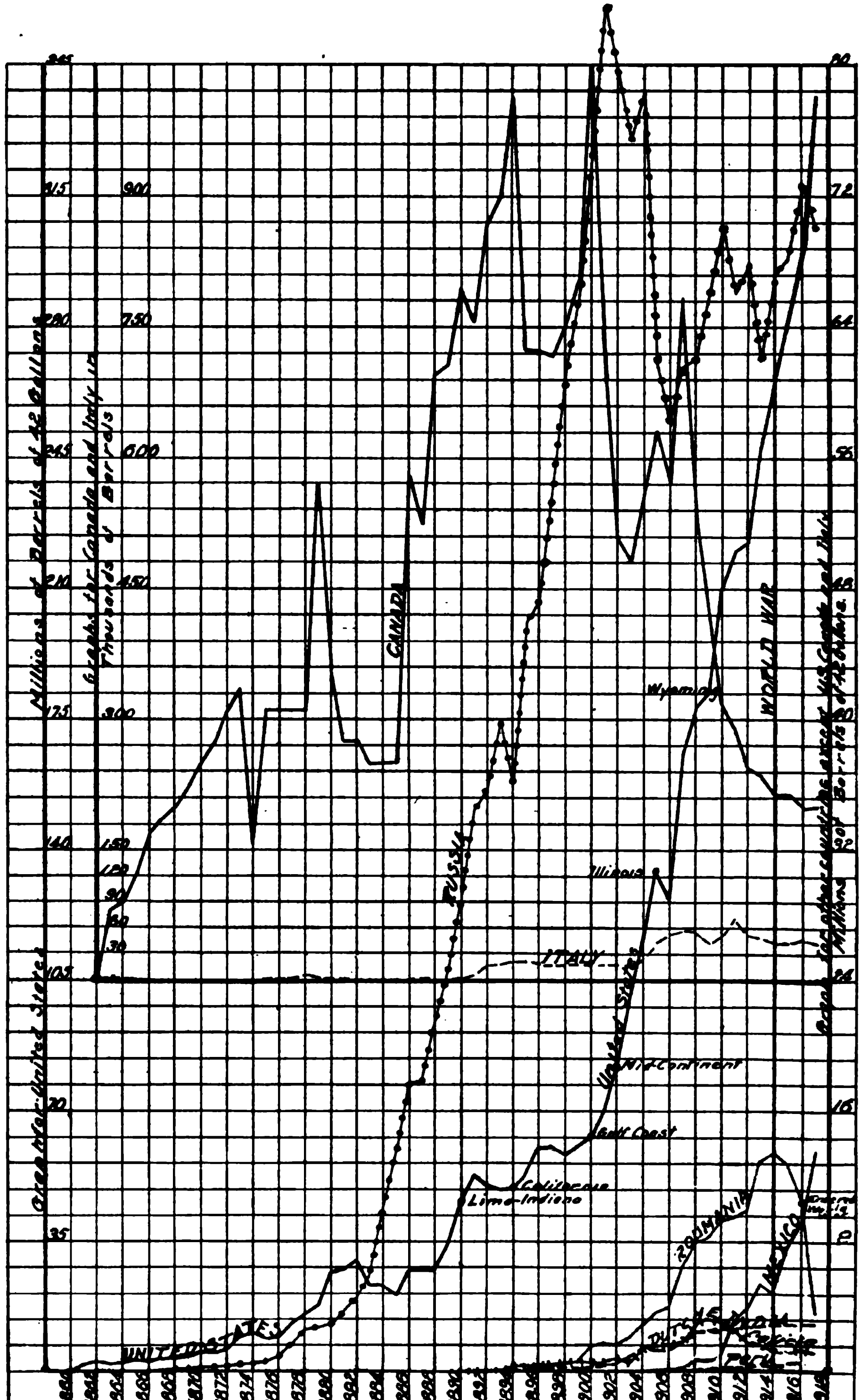
Roumania.

The principal oil fields in the order of

Analyses of Petroleum from Various States and Countries.

Location of Well	Specific Gravity at 15°C	Distillation by Engler's Method: Begins to Distill at (°C)	By Volume: To 150°C Cubic Centimeters	To 150°C Specific Gravity	150° to 300°C Cubic Centimeters	150° to 300°C Specific Gravity	Residuum Cubic Centimeters	Residuum Specific Gravity	Total Cubic Centimeters	Sulphur (Percent)	Paraffin (Percent)	Asphalt (Percent)	Water (Percent)	Unsaturated Hydrocarbons (Percent): Crude	Unsaturated Hydrocarbons (Percent): 150° to 300°C	Remarks
Colorado—																
Boulder County	0.8304	...	16.0	0.7368	40.0	0.8000	44.0	......	100.00	....	....	......	....	....	...	Burning oil, 150°F, fire test.
Fremont County—Florence	0.8696	...	....	......	35.40	......	....	......	......	....	10.4	......	....	19.0	...	Fixed Carbon, 1.6; Chart of Residuum, soft; loss 200°C (7 Hr.) 2.4%.
Illinois—																
Ohio Oil Co., Martinsville	0.8780	70	10.0	0.7326	33.0	0.8183	57.0	......	100.0	0.23	....	......	....	....	...	
Indiana—																
Grant Co., Van Buren	0.8531	...	7.2	0.719	32.6	0.7965	60.2	......	100.0	0.83	....	......	....	....	...	300° to 350°C 14.8%; sp. gr., 0.844.
Kansas—																
Prairie Oil & Gas Co Pumping Station Rantoul	0.8578	103	5.5	0.7220	33.5	0.7850	59.7	0.9217	98.7	....	4.34	1.93	....	26.4	6.0	
Louisiana—																
Caddo Oil & Gas Co., E. K. Smith's farm	0.9211	200	....	......	14.0	0.8142	59.0	0.8974	73.0	....	3.64	0.34	20.0	....	...	0.7 per day clay.
Ohio—																
Lima	0.7910	23	16.0	0.7000	68.0	0.788	16.0	.....	100.00	....	....	......	....	....	...	Paraffin oil, 6%; sp. gr., 0.813.
Belle Valley Pool, Noble County	0.8240	57	13.0	0.7250	28.0	0.7463	55.8	0.8805	96.8	....	5.44	0.0	....	3.2	4.0	Kerner sand.
Milner Pool, Morgan County	0.8046	74	14.5	0.7137	38.5	0.7815	43.6	0.8669	96.6	....	5.36	0.0	....	11.6	5.0	First Cow Run Sand.

Oklahoma—																	
Glenn Pool	0.8459	112	7.5	0.7464	42.0	0.7980	50.0	0.9061	99.5	....	5.41	0.11	....	21.2	6.0		
Chelsea Pool	0.8511	80	13.5	0.7148	31.0	0.8035	54.8	0.9168	99.3	....	9.00	1.26	....	26.0	8.0		
Pennsylvania—																	
Perry County	0.7901	...	17.0	0.693	43.0	0.765	40.0	......	100.0	....	....	......	....	....	...		
Texas, Harris County—																	
Humble Pool	0.9198	118	0.5	......	40.0	0.8646	58.3	0.9615	98.8	....	0.0	3.17	Tr.	26.4	5.0		
Spindletop Pool.......	0.9085	135	0.5	......	37.0	0.8611	62.3	0.9316	99.8	....	0.0	0.0	Tr.	22.8	8.0		
Wyoming—																	
Big Horn Basin......	0.8315	77	14.0	0.7220	45.5	0.7800	40.5	......	100.0	....	....	......	....	....	...		
California—																	
Coalinga	0.915	70	5.7	0.771	34.1	0.862	....	......	100.4	(a)	Tr.	0.0	0.0	....	...	(a) Asphalt, commercial value in (%).	
Whittier Field	0.929	46	4.2	0.773	38.3	0.870	....	......	......	....	....	......	....	....	...		
Mexico—																	
Tampico	0.7839	155	....	......	98.0	0.7829	2.4	......	......	1.11	....	(a)59.1	0.4	....	...	(a) not determined.	
Japan—																	
Echigo	0.862	...	21.8	......	38.8	......	....	......	......	0.61	....	(a)39.6	0.0	....	...		
Russia—																	
Grozoni	0.869	...	13.4	0.730	25.6	0.808	....	......	......	....	....	......	....	....	...		
Rumania—																	
Campina	0.824	...	37.7	0.729	30.5	0.823	....	......	......	....	....	......	....	....	...		
Italy—																	
Villeia	0.787	...	55.0	......	42.0	......	....	......	......	....	....	......	....	....	...		



Graphs Showing Oil Production of the World by Countries.

their importance are the Bushtenari, Campina, Moreni, and the Filipeshti-Baicoi. The oil industry of Roumania is mainly centered at Ploeshti, around which the main refineries of the country have been located. There is a system of private and public pipe lines from all the important fields with inter-communication between the refineries.

Foreign capital has played an important part in the development of the Roumanian oil industry. Large investments have been made by English, French, German, and Dutch capitalists.

The petroleum occurs principally in the Miocene and Pliocene series, but the Eocene and Oligocine contribute largely to the total production. The strata consists chiefly of marly-shale, alternating with beds of sand and sandy clays, with occasional seams of pebbles.

Galicia.

The rapid expansion of production in Galicia following a long extended gradual growth, and succeeded by a rapid decline, has attracted much attention to these most interesting fields.

Oil has been known for a long time and was prospected and recovered from the ground by hard drilling. The difficulties due to disturbed geological conditions were not lessened by the scarcity of good casing, and it remained for the Canadian system of drilling to enable real progress to be made.

The chief fields of Galicia are in Eastern Galicia. They are: Bitgow, Bodrka, Potok, and the Garlice Districts.

Burma.

The oil fields of Upper Burma have steadily acquired increasing importance, and achieved fame because of the enormous profits earned in recent years. For many years the restricted production was drawn from shallow wells at Genangyaung and Genangyat, some 200 miles north of Ragoon on the Irwaddy River. Deeper drilling in the Genangyaung field by an enterprising operator discloses the existence of much richer sands than had been suspected, and the industry quickly leaped into considerable prominence.

The Genangyat oil field is young in its development, but will some day attract activity. Only a small acreage has been developed, but the light density of the oil will be certain to attract capital shortly. Numerous districts of Burma also show promise, and the delays in prospecting may be chiefly attributed to their distance from the river, the only medium of transportation.

The oil is derived from anticlinal folds in strata of Tertiary age; in some places the oil horizons are associated with coal beds. They are worked to some extent.

Dutch East Indies.

Oil fields of immense value and great extent have been discovered and operated in the Dutch East Indian Islands of Borneo, Sumatra, and Java.

Extraordinary results have been achieved in a short space of time. The oil is found in anticlinal folds with steeply dipping sides. The axes are generally characterized by unusual exposures of interesting geologic phenomena. As in the Eastern oil fields, the oil strata are of Tertiary age, and are generally associated with coal or lignite. In Borneo there are both asphaltic and paraffin oils in the same field at different depths. Some of the Sumatra oils are especially rich in light-products. These have been in demand for the production of spirits for the European market.

There are, perhaps, thousands of square miles of oil-bearing territory which can be renumeratively exploited when the occasion demands. At present the Royal Dutch Company controls the whole of the Dutch East Indian oil fields.

Mexico.

Mexico has rapidly risen in importance as an oil producer. Although this is mainly due to the development of two areas, each with a few phenomenal producers, many other areas have been definitely proven capable of large production. It may now be said that from Vera Cruz to Tampico is practically one oil field.

Generally speaking, Mexican petroleum is very heavy in the northern fields, ranging in density from 10 degrees to 14 degrees Baumé, and is used for fuel, but in the south lighter varieties are found. The oil of the San Cristobal field varies from 26 degrees to 30 degrees Baumé.

The handling of Mexican oil is being gradually simplified and cheapened by the construction of pipe lines and railroads. In 1914 there were 420 miles of 8-inch pipe-lines and fifty more in construction. Practically all the pipe lines lead to the refineries at Tampico and Minatitlan, but much oil is extracted without treatment.

South America.

The deposits in South America appear to possess great potential importance. Only those of Peru have thus far been systematically worked. In the Argentine Republic, a field was accidentally discovered when drilling for water, and this may provide the clue to other discoveries in the country. Geological survey is now being undertaken and their reports are most promising.

Venezuela.

A contract was entered into with the Venezuelan government in 1909, for the exploration and exploitation of the oil fields of the northern part of the country. Previous to this the only active work had been carried out by a local company which for some years produced oil from shallow wells. Both petroleum and asphalt occur in the deposits in the eastern section of the field. These are a continuation of those of Trinidad.

Argentina.

The province of Salta has long been celebrated for its oil springs and bituminous shales. One drill-hole is said to have yielded 300 barrels daily at a depth of 400 feet. In 1890 there were five producing wells near Mendoza. Other developments have been slow. The oil was used partly as fuel in the locomotives on the Argentine Great Western Railway, and partly as a source of light. The oil, which is of a heavy asphaltic character, is found at a depth of about 1,800 feet. Some of the wells flowed, but most of them require pumping.

As a result of a conference held by the Administrative Commission in charge of the exploitation of the petroleum deposits, investigations have been made with the object of showing the extent of the oil belt, the depth of the petroleum-bearing strata, and its thickness. It has been proposed to sink wells in different points of the reserved zone. Oil wells which were drilled 1,800 feet deep without encountering oil are then to be sunk to 3,600 feet, the limit of the boring capacity at present.

The production is gradually increasing. In 1916 it reached nearly 1,000,000 barrels.

Peru.

Peru can boast of one of the finest oil fields in the world. Along the coastal belt of Tertiary rocks, extending from near Tumbez, on the northern frontier, to Payta, a little south of Point Parinas, there are numerous indications of petroleum. To date at least three important fields have been discovered. Additional oil discoveries were made on the Haulaga River near Guremagnas. The oil is of good quality. Prospecting has been actively carried on throughout the district, but the production of oil from old fields increased to what will mean a peak production unless new fields are developed.

Favored by a healthy climate, the tropical heat tempered by perennial cool southern breezes, the absence of rain and desert-like surroundings impose no hardships, and enable work to proceed in a way unknown in any other oil country. Drilling is easy and rapid, no water difficulties occur, and the light density of the oils are much sought after for the extraction of petrol.

There is a well-equipped refinery at the Port of Talara, where various products are prepared, cased and shipped to the west coast markets from Chile to California. There is also a small refinery at Zorritos. Fuel oil is largely used by the railways of Peru, by some steamships on the coast, and by the Nitrate Oficinas of Chile.

ARKANSAS, A PROMISING FIELD FOR THE PROSPECTOR.

By H. A. Everest, '08.

Undeveloped mineral possibilities are many in Arkansas. They range from lead and zinc, copper, manganese, antimony, bauxite and graphite to diamonds. Sulphides bearing cobalt and nickel and lead ores bearing silver have also been found.

Bauxite is the largest mineral industry at present (coal excepted). Several plants are close to Little Rock. Next in importance are the zinc mines in Northern Arkansas, in the vicinity of Vellville, in the southern part of the Ozark Uplift. During the war, Batesville became the center of manganese mining. There was also a small production in the Ouchita region. There are large deposits of iron ores carrying considerable manganese in the vicinity of Mena. Changes in smelting practice may make these deposits valuable.

The ores in the zinc mines of Northern Arkansas are chiefly oxidized, though sulphides are found in the deeper workings. In prospecting, look for the silicate and the carbonate. Hydrozinkite is said to be present in many places. These ores are often hard to recognize and have been overlooked many times by experienced prospectors. The ores occur in breccias, more or less horizontal in extent, in old solution channels and in clays as residual deposits. There are many chances for the discovery of new deposits in this region.

The Ouchita Uplift is a low mountain range extending southwest from Little Rock across the state and into Oklahoma. These hills are composed of Carboniferous and older rocks. They are much faulted, folded and intruded in many places by igneous dikes. These intrusions extend from near Little Rock to Murfreesboro, in Pike County. The large mass at Little Rock is a syenite, variety, Pulaskite. It is known locally as blue granite. The intrusions near Murfreesboro have been classified as a peridotite, variety Kimberlite. It is here that between 1,500 and 2,000 diamonds have been found. The stones were small but of very good color. Erosion has been very rapid in this region and sulphides occur within a few feet of the surface. Shallow trenching frequently exposes sulphide ores. This region is well mineralized; one man collected over 100 minerals in one short trip. There is very little active mining in this region, although there are a good many prospects and some have equipment installed. The possibilities of finding new deposits are very good. In the past the tendency has been to start digging without thorough surface prospecting.

Coal deposits are in the west central portion of the State. The coal varies from Anthracite on the eastern end of the field to a Smokeless Semi-Anthracite at the Oklahoma line. There is a very good demand for the Anthracite as its nearest competitor comes from Pennsylvania. The other coals have a high heating power and are unexcelled for steam purposes.

Much information has been published by the Arkansas Geological Survey, the U. S. G. S. and, in recent articles, by the Engineering and Mining Journal. The State maintains a geological department at Fayetteville in connection with the State University, and a Commissioner of Mines and Agriculture, at Little Rock, who will furnish information regarding the State. About one fourth of the mineralized areas is government land subject to the location of mineral claims. The rest has been deeded and can be bought or leased. In many cases titles are obscure due to carelessness in recording deeds or probate proceedings.

MAKE THE MINE TIMBERS LAST.

Mine owners find that it is absolutely necessary to keep all timbers used in the interior of the mines in the best of condition as in years past many cave-ins and accidents have resulted from the deterioration of timbers. These timbers, used as supports and struts across the top of the passage-ways in the mines, are subject to the action of gases and fumes, which occur in the mines, and also to insect attack. These different destructive agencies cause the decay of the wood and as a result the timber lasts only about six or seven years on the average. Of course, they may not actually fail at the end of that period, but beyond that time their condition is such that they are considered unsafe.

It has been found that the life of the timbers can be doubled and even trebled by coating them with a creosote compound which will fill up all the pores on the exterior of the timber and prevent gases, fumes, etc., from acting on the wood. The coating of these timbers is a very simple process and is quite economical. When it is considered that the life of the timbers will be greatly lengthened and constant repairs along the shafts and passageways in the mines eliminated, as was the case when uncoated timbers were used, it is readily seen that this creosote covering will be a very profitable investment for mine owners.

UNIT-COST ESTIMATES FOR SMALL HYDRO PLANTS.

From Lefax, Inc.

Elect. World, April 12, 1919. The high cost of fuel is causing the investigation of many small water-power possibilities, and the following data from an estimate of the construction cost of a 180-kw. installation in Massachusetts are suggestive. The total estimated cost of the development was $50,000, or about $277 per kilowatt (March, 1919, prices). The unit costs in the estimate included:

Earth excavation, per cubic yard	$1.50
Ledge excavation, per cubic yard	4.00
Two 90-kw. generators, per kilowatt	40.00
Installation of generators per kilowatt	8.33
Two 42-in. turbines, 21.4-ft. head, per kilowatt of plant generating capacity	38.80
Installation of turbines per kilowatt plant generating capacity	8.33
Gates and Racks, per kilowatt	2.78
Concrete wheel Masing and draft tube installation, per kilowatt	5.55
Power plant building, per square foot (brick)	6.00
Concrete canal and forebay, per kilowatt	28.80
Concrete penstock (length 740 ft., inside diameter 5 ft., 6 in.), per kilowatt	55.50
Engineering and incidentals	24.50

If you would be continuously happy you must know when to be blind, when to be deaf and when to be dumb.

TECHNICAL REVIEW

GENERAL.

Last month we failed to digest the June 28, 1919, issue of the E. & M. J. This is the "Annual Milling Number." It contains so many worthy articles that space will not permit our reviewing them. The following are a list of some of the most important:

1. The Roasting and Magnetic Separation of Wisconsin Zinc Ores.
2. Notes on Screening Practice.
3. Selection of the Power Plant for the Mill.
4. Shafting and Belting.
5. Design of Small Concentration Plants.
6. Economics of Concentration.
7. Notes on Flotation.
8. Working Adjustments of the Wetherill Magnetic Separator.
9. An Outline for Flotation Test Work.
10. Ammonia Leaching of Copper Ores.

C. E. W.

The June, 1919, issue of the Arizona Mining Journal likewise contains numerous interesting and instructive articles, which space will not permit our reviewing. Some of the articles contained therein are:

1. A Road to Promotion for Copper Camp Miners.
2. Mechanical Ventilation of Metal Mines in the Southwest.
3. Theory and Practice of Industrial Relationships.
4. The Story of D. C. Jackling.
5. Production and Price of Copper.
6. The Great Diamond Swindle.
7. Some Facts About Oil for Stock Buyers and Prospectors.
8. The Copper Situation.
9. Globe-Miami Mine Rescue and First Aid Association.

C. E. W.

Mining in Spain. By B. Mackay Heriot. (Mining Magazine, June, 1919.)

Contains general information of interest to mining men. The author describes the present living conditions in Spain; prices are high, labor restless and prone to strike without definite reasons. He calls attention to the fact that Americans are doing much advertising and investigating numerous new projects in Spain. Hydro-electric power is abundant. Only 300,000 kilowatts are harnessed out of a total of over 2,000,000. At present lead is the most important metal. Spain produces about one-tenth of the world's production. Pyrite and copper are next in importance. The author briefly mentions the various other metals mined, gives production statistics and the names of the producing provinces. Numerous favorable lead and cupriferous-pyrite properties and mines are awaiting development. C. E. W.

The Platinum Situation. By James M. Hill. (E. & M. J., July 26, 1919.)

There have been some misconceptions in the past relative to the uses of platinum which are attributable to the lack of appreciation of the fact that all commercial platinum is not the pure metal. The pure metal is not required for all chemical work, but for many purposes the iridium alloys are used.

The essential uses of the platinum group metals, in the chemical and electrical industries and probably the dental industry also, should be classed as essential.

The non-essential consumption of the platinum-group metals in jewelry must be stopped in order that industrial development may continue. The world's supply of platinum is small, and prospects for substantial increases in production are remote.

The shortage in platinum and the platinum-group is attributed to the disturbance of normal production by the war.

The article gives a geological distribution of platinum. Tables are given showing the analyses of crude platinum from various parts of the world, and the estimated world's production of placer platinum, 1909-1917 in troy ounces. G. V. D.

War's Influence on the Zinc Industry. By Pope Yeatman. (E. & M. J., July 5, 1919.)

The meeting of the zinc institute at St. Louis was an occasion for special emphasis upon the development of new uses for zinc and the co-operation between mines and smelters.

In this article many new uses for zinc are given, and it is suggested that the utilization of by-products should also be stimulated in order to reduce the cost of the main product. G. V. D.

Notes and Data on Fixed Nitrogen Plants. (Chemical & Metallurgical Engineering, July 15, 1919.)

Cost figures at the government's cyanide process nitrate plant at Muscle

Shoals were made public for the first time during the recent hearings before the Committee on Military Affairs of the House of Representatives. Tabulations were presented showing the detailed costs of manufacturing calcium cyanide, ammonia gas, nitric acid and ammonium nitrate this spring when the plant was operated at 20 per cent of its capacity in a test run. An estimate is given also of the costs had the plant been operated at full capacity. G. V. D.

The Copper Industry of the Southwest. By W. Toyote. (Mining Magazine, June, 1919.)

The concluding article of the one which appeared in the May issue (reviewed in July number of C. S. M. Magazine). The author gives the geologic columns of several of the mining districts and geologic sections of some of the others. The history, geology, geographic and topographic features of other districts not described in the May issue, are given. Brief notes are included on the advent of the "Porphyries," change of smelting from blast furnace to reverberating methods, and the change in living and social conditions of the mining camps. C. E. W.

Physical Examination Previous to Employment. By Charles F. Willis. (A. & F. M. Bulletin, July, 1919.)

An article describing the importance of a physical examination in order to intelligently place men in positions for which they are physically qualified without endangering the safety of their co-workers. The unfit, only in rare cases, are rejected. The aim is to help the individual to regain his health and at the same time give him employment which fosters this end.

The author describes the work done by the Phelps-Dodge Corporation at Bisbee. C. E. W.

MINING.

Placer Mining in Oregon. By A. E. Kellogg. (E. & M. J., July 19, 1919.)

The original "old channel," or bed of the ancient river, has recently been uncovered at the Esterly Mine, situated in the Waldo district, in the southwest part of Josephine County. A pit 25 feet below the level of the former workings has been piped, and operations have opened up a bed of gravel that shows a different character from the clay banks which have proved so profitable during the last fifty years of active operation of the mine. The extent of the new deposit has not yet been determined.

A hydraulic elevator system has been erected to provide sufficient grade for the disposal of tailings. These hydraulic elevators, which have a lift of 89 feet, will be replaced by a "water classifier" that requires driving a 700-foot tunnel. This will reduce the operating costs.

The "water classifier" is Mr. Esterly's own invention, and he is confident that it will recover 90 per cent of the values. G. V. DUNN.

Sinking and Concreting Mine Shaft 936 Feet Deep. By Richard L. Russell. (E. & M. J., July 12, 1919.)

Several novel details in underground construction were developed and applied in sinking and concreting shaft No. 5 of the Miami Copper Co., at Miami, Arizona. This shaft has four compartments and is 936 feet deep, and the concrete lining was carried on at the same time as, and without interference with, the sinking. Seven hundred feet of the shaft lining were placed and two large stations excavated and concreted by the time the shaft reached its final depth.

Although the material is very hard, no blasting was done after water was encountered at a depth of about 200 feet. It was found practically impossible to remove the powder fumes from the fissures in the water-laden hardpan. G. V. D.

Electric Blasting Equipment. By L. D. Rowell. (E. & M. J., July 12, 1919.)

The experience of the army in the recent European war brought out certain weaknesses and faults in the equipment used in electric blasting, and led to the development of apparatus which, it is hoped, will find a permanent place in the commercial field. It is not the purpose of this article to discuss the method of setting-off blasts, in general, but to present certain features of the problem as it affects general practice in the use of electricity for the detonation of explosives.

The article shows the dependability and conditions under which electric detonating caps can best be used, the methods of testing and the advantages in the use of the Olun-Meter. G. V. D.

Matachewan Gold Area. By H. C. Cooke, (Canadian Mining Journal, July 16, 1919.)

The report covers the prospecting which has been done on the gold deposits of the Matchewan District, Ontario. It is accompanied by six sketches which give the location and geological structure of the district. There is a description of the schist ore-bodies and the adjacent rocks. A conclusion is made of the probable source of ore and the rock structure.

P. F. BROWN.

The Use of Oil in Diesel Engines. By L. H. Morrison. (E. & M. J., July 26, 1919.)

Specifications must be definitely established and conform to most efficient operation. Treatment, filtering, conveyance, and storage of oil are important factors. The construction and situation of tanks should be planned carefully.

Mr. Morrison uses sketches showing a buried steel storage tank, a home-made filter for fuel oil, a concrete storage tank, and a sectional view of a Koerting nozzle for gas oil and tar oil.

G. V. D.

Ancient Tin Mining in South Africa. (E. & M. J., July 19, 1919.)

In the course of their prospecting the ancients often came upon rich ore. They followed it down until driven out by water or the rock became too hard to mine. Where ore occurred in pockets, flats, or pipes it was followed and taken out with a cleanness that is truly astonishing. Generally speaking, the ancients mined so thoroughly, and left so little behind them, that in one instance the occurrence of ore left in place is very interesting. The old mines must have been disturbed and left suddenly—either a raid occurred or the entrance must have fallen in—otherwise they would not have abandoned such a large number of stone hammers, nor would they have left the working unfilled and a face of good ore for their modern successors, who have taken from the deposit approximately seventy tons of ore containing 7 percent metallic tin.

The article explains the methods of breaking ground, the manner of stoping and timbering, lighting, and the metallurgical and smelting processes employed by the ancients. G. V. D.

Machine Stoping in Narrow Lodes. By Cyril W. Gudgeon. (Chemical and Mining Review, June 5, 1919.)

The Giblin Lode of the Mt. Bischoff Extended Tin Mining Co., N. L. Wasatah, Tasmania, has averaged only 19.5 inches in width during the last five years of operations. The dip averages about 35 degrees, but it varies from nearly flat to vertical. Over 65,000 tons of tin ore have been mined. Accurate costs have been kept to show the comparison between hand-stoping and machine-stoping, with the following results:

1. Tons mined per man-shift:
   (a) Hand-stoping, 1.2 to 1.5.
   (b) Machine-stoping, 2.3 to 3.1.
2. Stoping width necessary:
   (a) Hand, 4 ft.
   (b) Machine, 2.5 to 3 ft.
3. Feet of holes drilled per shift:
   (a) Hand, 6.87 ft.
   (b) Machine, 28.54 ft.
4. Hand-stoping enables better hand-sorting.

To produce 1 ton of 70 percent SnO_2, 84 tons of hand broken crude ore must be mined in comparison with 100 tons of machine broken crude ore.

5. Cost of mining per ton of crude ore:
   (a) Hand, $3.10.
   (b) Machine, $1.75. C. E. W.

METALLURGY AND ORE-DRESSING.

The Chloride-Votalization Process. By Blarney Stevens. (Mining and Scientific Press, July 12, 1919.)

The idea of extracting metals from ore by a chloridizing roast and the simultaneous volatilization of the chlorides is attributed to Stuart Croasdale.

The process as now applied experimentally consists of mixing salt or brine with the ore and roasting it in a current of air at a temperature as high as it will stand without sintering too much. The fumes are collected by the Cottrell electro-static process, and may be treated in several different ways according to their character, the usual method being to mix them with the required amount of lime and a small amount of reducing agent and melt, recovering the valuable metals as bullion. The lime-chloride slag may be used in the roasting of more ore, so as to economize salt.

The chloride-volatilization process, if placed upon a practical basis might be useful in the following cases:

1. Desert ores, too much oxidized for flotation or other means of concentration.
2. Ores high in zinc and not suitable for smelting.
3. Ores that cannot be smelted because of the lack of fluxes for the formation of a fusible slag, or collection such as lead and copper. Deposits distant from a railroad are especially liable to suffer from such deficiencies. G. V. D.

Treatment of Complex Speisses. By Paul Papencordt. (Chemical and Metallurgical Engineering, July 1, 1919.)

Among the many intermediate products obtained in metallurgy, the speisses are perhaps the most troublesome. The recovery of the valuable metals from them is attended with unusual difficulty. It is not many years since speisses were discarded even by large smelters. In those smelters where speisses are treated the methods are tedious and often expensive. The purpose of this work was to devise a simpler process not subject to the excessive losses now suffered by smelters.

The article contains a description of recent research on the treatment of Complex speisses and the application of the results to commercial metallurgical processes. A proposed method is treating the speisses with pyrites in an electric furnace.

The suggestions embodied in the paper have great promise of solving the treatment of the complex speisses obtained in some copper smelting operations.

G. V. D.

Prolonging the Life of the Roofs of Reverberatory Furnaces at Anaconda. By Oliver E. Jager. (Mining & Scientific Press, July 19, 1919.)

The present practice of building ribs on the roofs of the reverberatory furnaces at Anaconda is an interesting example of the revival of an old idea.

At the Colorado smelter in Butte, the reverberatory roofs were built this way in 1899, and the scheme was tried on the first 50-foot furnace built at the present Anaconda reduction works in 1902. The lack of a sufficient variety of brick—shapes at that time caused the practice to be discontinued as impracticable. This difficulty has disappeared under present conditions, as plenty of different shapes are now available. This is an important point, since the success of the scheme depends on good bonding, so that there will be no opening nor falling of the roof between the ribs when the furnace is allowed to cool for repairs. G. V. D.

Graphite Mining and Milling in Alabama. By H. P. H. Brunwell. (E. & M. J., July 5, 1919.)

There are in Alabama large deposits of low-grade disseminated graphite ore that are easily mined. The graphite is of excellent quality and entirely of the cryptocrystalline variety, known in the trade as "flake graphite."

Since 1917, and with the advent of the oil-flotation method of concentration, the industry in Alabama has made excellent progress, and this method seems to have solved the problem of cheap extraction.

The superiority of the oil-flotation method of concentrating graphite over other methods employed has been demonstrated, and it is probable that all mills in the future will be equipped with one or other of the various types of machines on the market or by flotation apparatus of home construction. G. V. D.

Refining Flake Graphite for Crucible Use. By Frederick G. Moses. (E. & M. J., July 12, 1919.)

The U. S. Bureau of Mines investigated the possibilities of producing a satisfactory grade of crucible-graphite from Alabama flake-graphite.

Ferguson describes the requirements for crucible graphite as follows:

"Graphite for the making of crucible must be of great purity. Its content of graphite carbon should exceed 85 per cent and preferably should be as high as 90, and it must be practically free from mica, pyrite, and iron-oxide. A small amount of quartz is not injurious. Graphite for making crucibles should also be coarse enough for the interlocking fragments to be bound by the clay with which it is mixed. It should contain a large percentage of flake about 1 inch in diameter, and should all remain on a 100-mesh screen."

The concentrates produced in the Alabama district differ widely in their physical characteristics and graphite content. Hence a scheme worked out for anyone of the types can not be rigidly applied to the others. It was decided therefore, to select several of the most representative for investigation and to determine the extent that the results obtained on the concentrates could be generalized and applied to all. G. V. D.

Method of Handling Granulated Slag at Anaconda. By Oliver E. Jager. (Mining & Scientific Press, July 26, 1919.)

When the Anaconda reduction works commenced operations in 1902 not the least among the noticeable features was the ample provision for the disposal of slag. Seventeen years' operation, with increased tonnage during recent years, has altered this happy state of affairs, till at present, while it is true that there is still plenty of space on which slag may be deposited, there is no longer a free fall from the ends of the slag-launders. The system finally adopted for handling the slag may be regarded as a combination of the two standard methods of slag disposal, namely, granulation and haulage. In brief, the granulated slag is run unto settling pits, where the water is separated from it, the pits being then excavated mechanically and the slag put into cars, which are hauled to the edge of the dump and emptied. G. V. D.

Considerations on the Treatment of Flotation Concentrate. By Oliver E. Jager. (Mining & Scientific Press, July 12, 1919.)

Mr. Jager reviews briefly the new conditions that arise when flotation is adopted as part of the ore treatment process. Or, in other words, what changes, if any, must be made in the smelting process and equipment, and what differences are to be expected in the results, when a considerable proportion of the material to be treated consists of flotation concentrate. G. V. D.

Developments in Lake Superior Milling. By C. H. Benedict. (E. & M. J., July 5, 1919.)

Two principal types of copper ore are mined in the Lake Superior region. Both contain native copper, but differ materially, not only in the physical character of the gangue, but also in the physical character of the contained copper. These two types necessitate different methods of handling. The more complicated includes stamping, regrinding, tabling, leaching of sands by ammonia solutions, and flotation of slimes.

The latest development in the treatment of Lake Superior ores is the adoption of the flotation process. The leaching process has been used for the treatment of the sands, and flotation is so efficient that the leaching process could hardly compete with it even were the many mechanical problems solved that are involved in an effort to adapt ammonia leaching to the slimes. G. V. D.

OIL.

Some Facts About Oil for Stock Buyers and Prospectors. By G. Montague Butler. (Arizona Mining Journal, June, 1919.)

An excellent article which describes the basic and most important principles of oil geology. It is illustrated by eight stereographic cuts which so clearly elucidate the principles of oil geology that even a layman could readily comprehend them. The author enumerates the conditions involved which make oil drilling so hazardous. In conclusion, hints are given to prospective oil investors. C. E. W.

Irvine Oil District, Kentucky. By Stuart St. Clair. (A. I. M. E. Bulletin, July, 1919.)

The article fully describes the geology, oil occurrence and practical considerations involved in the oil production of the Irvine District. The district includes:

1. Area from Irvine, east to Compton.
2. Big Sinking area.
3. Beattyville area.
4. Ross Creek Pool.

The geologic column is:

Irregular shales, sandstone and conglomerate sandstone.

50 ft. dark-colored shales.

100-ft. Newman or St. Louis limestone.

450-ft. Waverly formation (bluish-green shales).

(Berea sand is found as the bottom member of the Waverly).

120-170-ft. Devonian or black shale formation.

(Bottom member a white fire-clay, 20 feet thick).

8-100-ft. Carboniferous limestone.

(This is the Irvine sand. It contains irregular porous sands which form the pools).

Silurian shales.

Ordivician limestone.

Oil occurrence:

In anticlines of two ages, modified by faulting. In the midst of a producing area the limestone may often be hard, compact and barren.

Economic conditions:

Author briefly mentions rapid advance in prices of land per acre and includes a brief history of the developments.

Author recommends one well to five acres. In general, with continuous pumping, a well will only produce about 10 per cent of its initial production at the end of a year. Life of wells two to three years. C. E. W.

Sealing Water in California Oil Fields. By Seth L. Langley. (E. & M. J., July 5, 1919.)

The productivity of oil formations is sometimes seriously affected by water penetration. Improved methods of sealing water-bearing formations that have been devised are here described.

G. V. D.

Bibliography of Petroleum and Allied Substances in 1916. By E. H. Burroughs. (U. S. Bureau of Mines Bulletin 165).

CATALOGUES.

The Jeffrey Manufacturing Co. have just issued Bulletin No. 270, which describes the "Jeffrey Straitflo Ventilators."

This type of fan eliminates the backflow of the common type of disc-fan. It should prove of interest to any mine operators who have a ventilation problem.

DISCUSSION

Mr. Lewis B. Skinner, '95, has requested us to publish the following article on "Technical Training," by M. L. Requa, which appeared in the Sinclair Magazine, June, 1919, in reply to the article by Dr. Royal P. Jarvis, '97, which was published in our April issue.

"To those young men who contemplate a career in the petroleum industry —or, for that matter, in mining of any sort or in the diversity of industries that have to do with engineering in all its multiplicity of forms—thorough technical education is today of greater value than at any time in the past. Tomorrow it will be still more valuable, and its value will increase as the years pass.

"The reason is simple, if we will but stop to consider and analyze the events of the last century. A hundred years ago our mineral wealth was practically untouched; the great West was an unknown wilderness; the revolutionizing inventions based upon steam and electricity were undreamed of. We were in large part a pastoral and mercantile people, untrained in the sciences which now form so vital a factor in our daily life. The great fabricating plants of all kinds that now dot the landscape from Maine to California were then unthought of; the family spinning-wheel supplied the wants now cared for by the factory crammed with intricate machinery. The home-made tallow dip afforded the light now supplied by electricity, gas and petroleum; and the horse transported from place to place the freight we now move by railroad and motor. The infinite and complex activities founded upon power have necessitated special knowledge, and that knowledge is now in large part being supplied by our colleges and universities through engineering courses.

"Science, after all, is but the record of experiments, successful and unsuccessful, which have been co-ordinated, catalogued, and filed away for future reference. It is the index, the record, of the activities of the practical man whose pioneer efforts in the field, the factory, and the laboratory are made available as a guide to posterity. And because of the complexity of modern engineering in all its branches, its constantly widening scope and growing literature, it is becoming more and more important that the young man upon the threshold of his career shall be familiar with past failures and successes; to the end that he shall not waste his time in attempting experiments long ago undertaken by others, the records of which are available for the asking.

"None of us, I am sure, would think of submitting himself to untrained hands if in need of a surgeon, nor would he knowingly commit his cause to one untrained in the law. The case of the youth about to enter the oil industry is to a great degree parallel—no one would think of giving him the job of drilling the well, producing the oil and transporting, refining and marketing it, unless he had first undergone a preliminary course of education, had served his apprenticeship. This apprenticeship may be served entirely in the field, but if it is served first in the classroom and thereafter in the field the result will, of course, be more satisfactory. And, given two boys equally endowed, the one possessing the technical education should not only far more quickly complete his practical apprenticeship, but he would in after years be more completely the master of his chosen subject.

"And, again, the reason is not far to seek: he has mastered not only the theory but the practice of his business; he knows not only what to do, but—and what is perhaps equally important—why he does it. I know, of course, that there are great men who have risen to premier rank in their several professions without a college degree, but I think it may safely be said of them that they would have the sooner arrived and would have saved themselves endless and laborious effort, if they had in the first place completed a technical course of training. The information slowly gathered in fragments here and there over the long years of practical apprenticeship could be far better mastered in four years of intensive training in college, where it is acquired in an orderly, co-ordinated, and complete way.

"We must not fall into the error of believing that a college degree is a certificate of ability. Far from it. The world is well supplied with men possessing sheepskins whose services would be dear at any price. Without the requisite foundation of character, all the diplomas on earth will fail to make their possessor a man of value. Common sense, that greatest of all fundamentals, is often notable by its absence among highly educated theorists.

"We are basing our discussion broadly upon the question as to whether or not a technical education is desirable for a young man about to embark in the oil business. In production, certainly, some geology as well as civil and mechanical engineering is of value. In transportation, mechanical engineering is almost a necessity: and in the refinery a course in chemistry is a prerequisite for any man who hopes to master the refining of petroleum in all of its branches and stand among the leaders of modern refining practices. I believe, too, that a salesman who knows something of the chemistry of oils, and who has served apprenticeship in a refinery, will, other things being equal, lead the way rather than follow the lead of others.

"All industrial activities should be constantly progressing. Inertia is fatal. And he who would lead or be near the head of the procession must of necessity have technical education as the foundation of its activities. He may not acquire it in college; it may come through the slow process of years of practical experience, but it is none the less necessary; and if four years will serve to acquire the fundamental knowledge that it would otherwise have taken fifteen or twenty years to gather, is it not the part of wisdom to adopt the former course?

"There are many young men who have already started out in their work without having had the opportunity to secure the necessary technical foundation. I believe that those who can would do well to spend a year or more at some technical school, and with that ground-work build the balance of the structure by home study. It does not follow that, simply because work has been commenced before the college course has been undertaken, the time has gone by. I know several men who have abandoned work for the classroom and who have afterward returned to their business career far better equipped for the struggle.

"The future has still in store many great discoveries in perhaps all lines of engineering endeavor. Certainly the end of invention has not yet been reached; there is much yet in store for the student who would venture upon pioneer expeditions into the realm of science. Learned mathematicians of the past demonstrated conclusively that the flying machine was an impossibility; and yet today we do fly. Petroleum may yet be made into edible fats; the heavy-gravity oils may be metamorphosed into 80 per cent gasoline; the impossible, so-called, may in years to come be found to be, after all, absurdly simple.

"It is a wonderfully brave man—or an ass—who confidently outlines the limits of possible future advancement in the realms of science. I think that about all we can say with assurance is that the future holds possibilities as yet unfathomed.

Technical Training Now Essential.

"Within the life of two generations conditions have been revolutionized. It was not particularly necessary for our grandfathers to be technically trained. Power, as supplied by steam, petroleum and hydro-electricity, was virtually unknown; and the myriad inventions that today depend upon power were undreamed of. Our children have other days to face, wherein the activities of the time will rest largely upon technical skill. He who would be a part of those activities must know some phase of them, and know it well. A mere smattering of knowledge no longer suffices.

"The man who is sought after today is the man who knows his subject thoroughly and who brings to the task not alone adequate training but common sense, honesty, and integrity, loyalty, and untiring energy. For such as these, opportunity beckons with insistent gesture. That it rewards only those who hold college degrees would be, of course, an absurd statement; but, all things being equal, the man with the technical training has an advantage that will be found difficult to overcome by those not so fortunate."

We earnestly beseech some of our readers to take part in this discussion. Refer to Mr. Skinner's original letter in the March issue and Dr. Jarvis' refutal in the April issue, and then take sides. —[Editor].

BREAKING UP CONCRETE.

Concrete structures, either plain or reinforced, are considered of the most permanent nature. It is, however, often necessary to remove or destroy such structures. It may be an old concrete wall, bridge abutment or pier, a foundation under a building, the lining of a tunnel or an engine bed. Many times these objects are inside factory buildings and adjacent to valuable machinery, or the mass to be removed may be in close proximity to buildings, or to a city street congested with traffic or under an office building.

An explosive of relatively slow heaving action, like ammonia 30% to 40% strength, is best adapted for such work rather than a very quick and shattering explosive.

PERSONALS

'97.

George F. Powell is manager of the El Tajo Mining Co., S. A., San Geronimo Camp, Poza, Sonora, Mexico. His home address is still at 4624 South Gramercy Place, Los Angeles, Calif.

'99.

Lester S. Grant, newly appointed Professor of Mining at the Colorado School of Mines, has arrived in Golden.

'01.

F. C. Bowman is president of the American Investment & Securities Co., with offices in the Jones-Kennedy Bldg., Wichita Falls, Texas. Bowman is always at home to Mines men who may be visitors in the oil fields.

'02.

G. M. Butler has returned to Tucson, Ariz., from a trip to New York, Baltimore, Washington and New Orleans.

'03.

A. D. Cox was a visitor in Golden recently. He has returned to Dome, Ariz.

'05.

E. L. Larison, superintendent of the Acid Plant at Anaconda, Mont., and family, are visiting in Golden.

'06.

Max W. Ball is manager of the Rocky Mountain Division, Roxanna Petroleum Co. of Oklahoma, with offices in Cheyenne, Wyo.

J. B. Brown is leaving for Pachuca, Hidalgo, Mexico, where he has accepted a position with the Cia Exploradora de Hidalgo, a subsidiary of the U. S. Smelting, Refining & Mining Co.

'07.

T. P. Ellis is now resident plant engineer, Southern Pacific District, Division of Shipyard Plants, U. S. Shipping Board Emergency Fleet Corporation, 932 Title Insurance Building, Los Angeles, Calif.

'08.

Jesse F. Boyd is now manager of the Cashin Mines Co. in the Paradox Valley, Montrose County, Colorado.

S. C. Sandusky has returned to his home, 222 F Street, Salida, Colo., from Oklahoma City, Okla.

Robert Elder has returned to America from the Chiksan Mines, Unsankinko, Chosen, Korea. Can anyone send us his home address?

'09.

Robert I. Kirchman of Silver City, New Mexico, was a visitor in Golden recently.

'10.

J. V. Hubbard is a horticulturist at Grass Valley, Calif. His address is P. O. Box 228.

'11.

Karl V. Geib had one of his hands broken and the other seriously lacerated by a fall of rock as he was ascending a raise in the Smuggler mine at Telluride, Colo. He is visiting at his home in Denver.

'12.

Leon M. Banks has returned to his home in Denver after sixteen months service overseas with the 27th Engineers. He took a short course in geology at the British Royal School of Mines just prior to his return.

'13.

Alfred R. Flinn has been transferred from the Denver office of the Empire Zinc Co. to their Hanover Mine at Hanover, N. Mex.

Lt. Frank A. Downes has returned from France, where he served eleven months with the 316th engineers. He is enjoying a well-earned vacation with his mother at Golden, Colo.

Walter C. Heinrichs and family are in Golden on a visit from Superior, Ariz.

'14.

Ralph W. Smith has gone to Scotts Bluff, Neb., where he is engaged in the mercantile business with Fliesback & Sons.

On July 7th, Melvin Brugger was married to Miss Allene Mildred McCully at Oklahoma City, Okla.

In the July issue of the Magazine it was mentioned that Melvin Brugger and bride were leaving for Rio del Pinar, where Brugger has a position with the Minas de Matahambre, but we did not receive the announcement in time for publication.

Lt. W. L. Beck, of the 316th Engineers, has returned to his home, 452 Elati Street, Denver, Colo., after ten months' service overseas. He will leave shortly to return to his old position as chief sampler at Cananea, Sonora, Mexico.

G. G. Grigsby has leased his farm at Platteville, Colo., and contemplates reentering the mining game. He is temporarily at his home address, 4328 Vrain Street, Denver, Colo.

Rufus E. Litchfield is now engaged in electric furnace work at Lockport, New York. His address is 78 Park Avenue.

'15.

F. Eugene Heatley has returned to his office, 1019 Foster Building, after a professional trip through the oil fields of Texas, Oklahoma and Kansas.

J. H. Greenwood, recently discharged from the army and residing at his permanent address, Salt Lake City, Utah, is making a placer examination for the Mascot Mining Co. at Hailey, Idaho.

Monroe O. Carlson has returned to his home in Denver from Burma, India, via Egypt, Turkey and Europe.

'16.

Lt. Charles R. Vorck has recently returned from overseas, where he served with the 115th Engineers. He is temporarily at Golden, Colo.

Frank A. Smith has gone to Poza, San Geronimo Camp, Sonora, Mexico.

'17.

Max T. Hofius has arrived in Denver from his home in British Honduras, Central America. He has accepted a position on the geological staff of the Midwest Oil Co. Address First National Bank Bldg., Denver, Colo.

Robert Higgins has returned to his home in Denver after two years' service overseas with the 28th Engineers.

P. C. Yuan was a visitor in Golden the latter part of July. He just completed a post-graduate course at Columbia University. He will leave for Telluride, Colo., where he expects to get some practical experience before returning to China.

Capt. Robert A. Thurstin, of the 308th Engineers, has just returned from a year's service overseas. His company participated in several major operations and after the armistice was signed they were stationed at the Coblenz bridgehead. Thurstin paid his Golden friends a visit the middle of July while on a short furlough. He expects his discharge soon.

Lt. Wm. J. Murphy has been discharged from the engineer corps attached to Fort Harrison, Indiana, and is temporarily at the Standish Hotel in Denver.

'18.

D. D. Riddle is an oil geologist for Fisher & Lowrie, with offices at 705 First National Bank Bldg., Denver, Colo.

Lt. Roger F. White has returned to his home after ten months' service overseas. Address, 1048 F Street, Salida, Colo.

'19.

Rene J. Mechin has left Nacozari, Sonora, Mexico, and has gone to Pachuca, Hidalgo, Mexico, where he has a position in the Engineering Department of the Cia de Santa Gertrudis.

He had a difficult time making the journey to Pachuca, because of "washouts" on the railroad. The Rio Grande River was on the "war-path" in order to give the bandits a rest.

'20.

Fred L. Service is acting engineer for the Tonopah Placers Company, with headquarters at Breckenridge, Colo. He is doing the preliminary testing of placer ground preparatory to dredging.

EX-MINES NOTES.

'94.

Does anyone know where Percy Williams is?

'03.

Capt. W. H. Wright has gone to Nome, Alaska, on professional business. He expects to be gone until the last boat leaves in the fall. Wright recently returned to his home in Golden from Washington, D. C., where he served in the Ordnance Corps.

'10.

F. M. Robbins is now assistant general manager of the Ross-Meehan Foundries Co. at Chattanooga, Tenn.

'11.

A. E. Brugger was a visitor in Golden recently after a short stay at his home in Columbus, Nebraska. He will return to the Diamond Fields of Belgian-Congo, West Africa.

'12.

C. H. Smith (Schmidt), chief engineer for the Continental Casualty Co., of 910 Michigan Ave., Chicago, Ill., was a visitor in Golden recently.

Smith left the C. S. M. in 1912 and went to the Michigan College of Mines to graduate.

'15.

C. T. Todd has left Butte, Mont., to make an extended visit with his parents at Oxnard, Calif., Route A, Box 463.

'17.

Lt. Chas. N. Beyrle has just received his discharge from the 115th Engineers. He saw eleven months' service overseas. He and his wife were visitors in Golden recently.

Registrar T. C. Doolittle and family have recently returned to Golden after a two months' vacation at Long Beach, Calif.

'13.

OBITUARY.

Thomas Wade Wright was instantly killed on July 21st by a fall of rock in the Junction Mine at Warren, Arizona.

Wright has been in the employ of the Calumet & Arizona Mines Co. ever since he graduated. At the time of his death he was a shift boss in the Junction Mine.

He is survived by his wife, who was Miss Emma Macvau of Denver, and a three-year-old daughter.

SCHOOL NEWS.

The following new courses will be given during the coming 1919-20 school year:

XIV. Geological Surveying. Lectures.
Some of the more important topics considered in this course are:
1. The various types of instruments used in geological surveying and the merits of each.
2. Preliminary preparation for geological surveys such as procuring a base map and studying previous geological reports.
3. Preliminary field work.
4. Methods of reconnaisance and detailed geological mapping.
5. Influence of topography and structure on the distribution and width of outcrops.
6. Special problems likely to be encountered and their solution.
7. Actual practice in geological surveying at Golden and vicinity.

XV. Oil Field Development. Lectures.
The more important subjects presented in this course are:
1. Economic and geologic factors influencing the location of test wells and the development of drilling.
2. Methods of determining probable depth of "pay" sands.
3. Methods of drilling.
4. Spacing of wells.
5. Offensive and defensive tactics.
6. Casing off water and gas.
7. Interpretation of well logs and the construction of structure contour maps.
8. Gushers.
9. Swabbing wells.
10. Pumping wells.
11. Methods of determining the probable life of oil wells and their total production.

XVI. Interpretation of Maps. Lectures.
In this course the various types of topography and geologic maps are studied and the student is taught to interpret at a glance, the physiographic and geologic history of the region represented. The maps are so selected that every known type of topography and geological structure is represented.

XVII. Geological Seminar. (Elective.)
In this course the current literature on geology and mineralogy is reviewed and reports on original investigations by the faculty and by students in geology are presented. Each student who registers for the course will appear on the program at least once during each semester. Students not registered are welcomed as visitors.

XVIII. Geological Seminar. (Elective.)
This is a continuation of course XVII and may be taken only with the consent of the instructor.

XIX. Geological Research. (Elective.)
All students specializing in Mining Geology are urged to prepare a thesis during their senior year on some geological subject acceptable to the head of the department under whose supervision the investigation will be carried on. The credit allowed will depend upon the nature of the problem selected and the amount of time required for its solution and the preparation of suitable report. Hours will be arranged. (Van Tuyl.)

Chemistry.

XVIII. The Chemistry of the Hydrocarbons. Lectures. (Elective.)
The organic chemistry of the compounds of hydrogen and carbon; the preparation, physical properties, chemical conduct, and uses of the hydro-carbons obtained from natural gas, coal, petroleum, and oil shale.

XIX. Petroleum Lectures. (Elective.)
The chemistry and technology of refining; the ultilization and testing of petroleum and its products.

XX. Petroleum Laboratory. (Elective.)
Distillation of petroleum to determine the yield of naphtha, gasoline, kerosene, lubricating oil, and coke; determination of the specific gravity, flash point, fire test, and viscosity of the distillates; and the determination of sulphur, paraffin wax, asphalt, and the nature of the hydrocarbons in petroleum.

Civil Engineering.

VI. Roads and Pavements. Lectures.
A practical course in which modern methods of road construction are studied and in which the student is made to appreciate the necessity for, and value of, good roads from an economic standpoint. Various materials used in road construction are considered and their adaptability to the class of traffic to which they will be subjected. Practical problems involving the computation of earth work, haul, and quantities of materials are taken up, together with methods and costs in connection with the labor organization. Specifications for road construction in various localities are carefully considered as an illustration of how practice differs according to materials available for construction, and the particular purpose of which the road may be built.

X. Reinforced Concrete. Lectures
In this course emphasis is put upon the action of reinforcing materials placed in concrete. The manner in which concrete and steel may be combined most economically, so that each material takes upon itself those stresses which it is properly suited to bear, is very carefully studied. The aim is that in any given design the student may have sound reasons for a certain distribution of materials, rather than that the very common method of "guess and try" be adopted. Very numerous problems involving placing of reinforcement for various kinds of action are worked out in detail and a careful study of the many kinds of reinforcements on the market is made, and then their adaptation in various types of construction discussed.

Electrical Engineering.

IX. Electric Power Plants. Drawing.
This course includes the study of modern practice in the electrical equipment of steam-electric and hydro-electric power plants such as used to supply power to individual mines or groups of mines. A study is made of the fundamental considerations involved in selecting the units best adapted to particular conditions, in order to combine efficiency in operation and continuity of service with as low first cost as practical. The construction and use of the various types of switchgear, essential measuring instruments, and indicators, voltage regulators, and protective devices are taken up and discussed from the engineering standpoint. The course is largely practice in the design of the electrical part of the power plant equipment and involves making working drawings of plant lay-out, including circuit diagrams from the generating units through the switchboard and transformers to the outside lines.

X. Power Transmission Lines and Substations. Drawing. (Elective.)
This course is a study of the high-voltage lines, insulators, towers, and line protective devices used in transmitting electrical power from the generating station to the

mines and includes the substation with its transformers, rotary converters, motor generator sets, and other apparatus required to change the voltage, phase, or frequency of the current to that desired for local distribution. This course also includes the most economical size of wire to use under given conditions, determining the proper transmission voltage and spacing of the wires, selecting insulators, finding the best height and spacing of poles or towers, and the design of a substation.

Military Science and Tactics.

The work of this department is arranged to give the student a fundamental training in military science and tactics, an understanding of engineering from the military standpoint, and experience as a cadet officer and non-commissioned officer. This work, with the other technical courses a student must complete to obtain a degree, qualifies the graduate for a commission as 2nd Lieutenant of Engineers in the Officers' Reserve Corps.

Basic Course. This section includes all training given in the freshman and sophomore years and covers the following:

Infantry Drill Regulations—School of the soldier, squad, company, and battalion, bayonet training, combat formations and ceremonies.

Manual Interior Guard Duty.

Field Service Regulations—March discipline, service of security, service of information.

Small Arms Firing Manual, including range and gallery practice.

Military Engineering—Trenches, obstacles, revetments, knots and lashings.

Military Policy and Obligations of Citizenship.

Military Organization.

Advanced Course. This section includes all training given in the junior and senior years and covers the following:

Military Engineering—Field fortifications, engineer reconnaissance and sketching, military mining and demolitions, military bridges, roads, and railroads.

Military Tactics—Offensive and Defensive combat, use of engineer troops, map reading, and manoeuvres.

Court Martial and Elements of International Law.

Company Administration, Property Accountability and Staff Duty.

Duty of Officers and Noncommissioned Officers.

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The Alsatian Potash Industry*

By Frank K. Cameron.†

The Deposits.

There are two large deposits or groups of deposits of potash salts which, at the breaking out of the great world war in 1913 and for several decades preceding, were practically the only commercial sources of supply for the entire world. In both cases the origin of the deposits was sea water, the potassium salts being deposited by desiccation, but there were modifying factors which were not entirely the same in both cases, so that well defined and important differences exist in these deposits. The larger and better-known group, called the Stassfurt Deposits, are in Germany in the region about or adjacent to Magdeburg and Halberstadt. The general character of these deposits, and the methods of recovering potash from them, have been frequently described, not only in technical publications, but in the non-technical propaganda long maintained by the **Kali Syndikat**, an organization founded on a "cartel" with the supervision and support of the late imperial German government.

Less well known are the smaller though nevertheless extensive deposits in the neighborhood of Mulhouse in Upper Alsatia, which were also under the control of the Kali Syndikat at the breaking out of the war, but have now passed to French control, with the re-entrance of Alsace into the French Republic.

The Alsatian deposits, while less extensive than the German deposits, are, nevertheless, of great magnitude. They occupy a large part of the area between the Vosges Mountains and the River Rhine, from Colmar on the north to Mulhouse on the south. Indeed, a few borings on the east bank of the Rhine indicate that the deposits may extend under the river and to some distance beyond Buggingen-Linken, Baden, though it has not been shown as yet that this extension is of commercial significance.

As is well known, the Stassfurt potash occurs as potassium chloride or potassium sulphate or both salts, intimately mixed with salts of sodium, magnesium and calcium (lime) and contaminated with substances, insoluble in water, such as ferric oxide, clay, etc. The potash salts are segregated in more or less extensive "pockets" throughout the salt mass, these segregations departing usually from the horizontal. But the main "potash region" is a stratum varying from 30 to 150 feet in thickness and at a depth requiring shafts 5,000 feet.

The physical and chemical characteristics of the Alsatian deposits are quite different. At an average depth of about 1,800 feet lies the "lower" layer, or bed, practically (though not strictly so because of faulting) a continuous stratum of a mixture of potassium and sodium chlorides of an area known to be upwards of 77 square miles and of an average thickness approximating 11.5 feet. This layer is not far from horizontal throughout its extent, with a dense, compact roof and floor of dry clay, so that mining difficulties are of minimum importance. About 20 feet above lies the parallel but less extensive "upper" bed about 4 feet thick. Both beds are more or less banded by layers of clay, these clay layers varying in thickness from a small fraction of an inch to several inches. The lower bed is now being worked, the less important upper bed being exploited in a few places only and being regarded as a reserve for future operations.

The cubic contents of the two layers is estimated to be upwards of 1,350,000,000 cubic yards, containing approximately 1,500,000,000 tons of salt or (a rough approximation), 275,000,000 tons of potash (K_2O), enough to supply the world's probable demands for two centuries.

The average potash content of the Alsatian salt mixture is certainly 18 per cent K_2O and possibly three or four per cent higher, while the average for the salt as mined in Stassfurt is probably about 12 per cent K_2O. In both regions individual samples may show wide variations, but the average for the run-of-mine is astonishingly even for the Alsatian product. Since the soluble salts in the Alsatian product are potassium and sodium chlorides alone (other salts being entirely absent or present in very small and negligible quantities), the preparation of pure potassium chloride is effected very easily and cheaply by a simple fractionable crystallization, whereas the presence of sulphates or more especially magnesium salts in the Stassfurt salts makes the preparation of a pure grade of potassium chloride a matter of appreciable expense and involves a more or less complex technology as, for instance, the well-known "carnallite cycle." On the other hand,

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† Consulting Chemist, A. S. & R. Co., Salt Lake City, Utah.

* War Minerals Investigation, U. S. Bureau of Mines.

The Why of the Cones

THE FOUR SALIENT CONE FACTS

1. **Crushing Force exerted proportional to force required.**
   The cones automatically size the particles so that each is subjected to the amount of force necessary to crush it—and no more.

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Stretch a string loosely between two supports.

From any point between these supports, suspend a weight, and see what happens.

The resultant of the forces due to the load falls within the lines of the cones, the ideal conditions sought by the designer of bridges and other structures.

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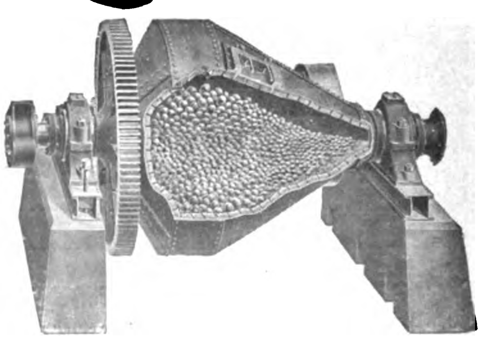

The Ownership of Minerals in British Colonies, the United States and Other Countries*

By David Bowen.†

It will be convenient to classify these countries into two main groups: (A) Those countries in which the law as to the ownership of minerals is in the main similar to that of the British Isles—i. e., property in minerals is vested in the proprietor of the soil, e. g., the Colonies, India, the United States of America, and Russia; (B) Those countries in which the basis of mineral legislation lies in the severance of the minerals from the surface soil, the rights to the minerals being under State control. This is the leading principle of the French Code of 1810, which has been followed by Belgium, Germany, and most other European countries.

General Considerations.

The subject under discussion is full of intricate questions of policy. Briefly, it may be stated that the three fundamental principles underlying the policy of all countries in relation to minerals are the following:

(1) The continuance of traditional or long-established customs, such as the generally recognized right of the proprietor of the soil to all things above and beneath.

(2) The desirability of conserving mineral resources and ensuring their proper development and avoiding wastage or locking-up of mineral resources. This is particularly desirable in cases where the land is divided up into small holdings whose proprietors are not sufficiently wealthy to undertake the proper exploitation of the minerals, or, on the other hand, are not in a position to work them economically. Again, the large landowner might in some cases be inclined to lock up his minerals and refuse to work them or allow them to be worked until he secured a high enough price for the minerals. The State in such cases seeks to regulate the opening up of mines, to compel the landowners to allow minerals to be worked, and to supervise the actual development of the mineral resources of the countries by various elaborate institutions—e. g., inspectorates.

(3) The third fundamental principle concerns the financial policy of the State. The State must secure some revenue in order to fulfil its functions. It may obtain part of its revenue either by disposing of its minerals as owner, or by instituting various taxes in connection with mining concerns.

These three fundamental principles governing the exploitation of mineral resources must sooner or later be balanced in every State. The third principle is, in some form or other, common to all States. The first and second principles are subjects of more or less acute controversy in nearly all countries. For the present we must leave this aspect of the question. Other aspects of the matter will be discussed in connection with subsequent articles on leases and taxation, and the whole subject will be reviewed in one of the final articles.

It will be convenient now to deal with the countries named in the order given.

(a) Countries in which Minerals are Vested in Surface Owners.

(1) British Colonies (excluding India).—Briefly, it may be said that in the British Colonies generally the property in minerals is vested in the proprietor of the soil, subject to the rights of the Crown in the case of lands reserved by the Crown, or in lands alienated by the Crown, but where minerals are reserved, and in the case of the precious metals, gold and silver.

The property in minerals in the different colonies in Australasia depends very much upon the principles adopted with respect to the waste or wild lands. The earlier grants carried with them, either at the time of the grant or by subsequent legislation, the full proprietary right to the coal lying beneath the soil, and under an Act passed in 1854 full property in the minerals could be obtained on payment of the sum of £4 per acre. The principal mineral areas are now practically private property, subject, as stated above, to the Crown rights in respect of gold and silver.

In Canada the property in minerals is vested in the proprietor of the soil in the case of private lands. In the case of public or waste lands the property both of the soil and of the minerals is vested in the Dominion or Provincial governments.

(2) India.—During the lapse of untold generations, despite domestic anarchy and foreign conquest, the Hindu village has in many parts of India preserved its simple traditional customs. The land was

† Capt. R.E., F.G.S., F.S.I., M. Inst. C.E.
* From the Colliery Guardian.

not held by private owners, but by occupiers under the petty corporations. The aggregate produce of the land was thrown into a common fund, and before the general distribution the headman was bound to set aside the share of the State.

The consistent aim of the British authorities has been to establish private property in the land so far as is consistent with the punctual payment of the revenue. Legal rights are everywhere taking the place of unwritten customs. These legal rights are granted in certain parts of British India under what are known as permanent settlements for purposes of revenue. This is notably the case in Bengal, where under such a settlement the property in minerals is vested in the individual to whom the soil has been granted in perpetuity. In other parts of British India and the native states the minerals belong to the State.

As to the precious metals, the only gold mines of note are situated in Mysore, a native state. The mines are worked under leases from the Mysore Government, subject to a royalty of 5 per cent of the gold produced.

(3) The United States of America.—The property in minerals in the United States is vested, as in this country, in the proprietor of the soil. This is easily understood, as, prior to the Declaration of Independence, the American States were British Colonies, and the old principles of common law in England held good in America. On the constitution of the Republic the several States conceded their rights in waste lands to the Federal Government. These public lands are administered directly by the Federal Government, but the private lands are subject to the laws of the individual States. In contradistinction to the state of things in this country, neither the Federal government nor the individual States have exercised their rights to gold and silver, although such rights are asserted in some of the statutes of some of the older States. It appears that the guiding principle of the Legislature, both Federal and State, has been to maintain private property in minerals and to create such private ownership in respect of minerals in public lands.

(4) Russia.—Prior to the Revolution, the right of the minerals in Russian lands was vested in the proprietors of the soil. There were, however, vast tracts which belonged to the Crown. The underlying principle of the Bolshevist movement may be traced back to the ancient customs of village communities, under which the land was subdivided into definite allotments of normal size, called bols. The headman (bolshoy) of the community had only a limited authority over his fellows; all important decisions affecting the community generally were taken by the council of the community. Whether the ultimate result of which the land was subdivided into definite allotments to the Russian people, or whether the long-established system of ownership existing prior to the Revolution will be continued, is open to doubt.

(B). Countries in which Minerals are Subject to State Control.

The French system has had an exceptional effect upon other European countries, and forms the basis of their legislation as to minerals particularly.

(1) France.—According to ancient customs, the privilege of mining seems to have belonged to the sovereign power. This was to a larger extent modified during the feudal regime, the right of mining being then vested in the feudal lords. But as the Central Government regained its power its ancient privileges were gradually resumed.

It may be taken that the Law of July 28, 1791, marked the beginning of modern French legislation as to mines. This Law was replaced by the well-known Code of 1810. The first article of the Law of 1791 affirmed that "Mines and open workings, metalliferous as well as non-metalliferous, as well as bituminous and other coal and pyrites, are at the disposal of the nation to this extent only, that these substances cannot be worked unless by the consent and under the superintendence of the nation."

Thus the rights of the State were recognized in the necessity for a concession and in the duty of the concessionnaire to work his minerals under State supervision. The surface owner had a preferential claim to all concessions, which he could transfer to a third party; he could claim no royalty, but could claim compensation for injury to the surface. But the Law of 1810 modified these provisions as follows:

A distinction was drawn between mines, minieres and carrieres; the principle of concession was adopted as regards mines, of permission as regards minieres, and of declaration as regards carrieres. The preferential right of the surface owner was taken away, but as under Article 552 of the Code Civil the right of the surface owner extended to everything above and below the surface, the surface owner was granted a share of the produce of the mine, such share to be fixed by the Act of Concession.

Various modifications have been introduced by subsequent legislation.

From the foregoing statement it is clear that under the French law the State is not the owner of the minerals, but yet has legal power to give permission to work the minerals to a concessionnaire. Further, the surface owner has no legal title to the minerals underneath. Until minerals are granted under a concession they are regarded as res nullius (things belonging to no one).

Generally speaking, the same principles are followed by the other European States.

(2) Belgium.—The French Law of 1791 was extended to Belgium in 1795, and the French Law of 1810 included Belgium. Certain differences from the French law were introduced at later dates. By the Law of 1837 the surface owner, or a combination of surface owners, were given preferential rights, subject to the claims of discoverers, to concessions. Other differences will be discussed in connection with subsequent articles dealing with leases and taxation.

(3) Germany.—Generally speaking, the French system obtains in Germany, but in some parts of Prussia and Saxony the minerals belong to the proprietor of the soil in virtue of ancient grants. It should be noted, also, that as a general rule the proprietary rights of comparatively common minerals—i. e., minerals other than gold, silver, lead, zinc, copper, tin, nickel, cobalt, arsenic, antimony, manganese, sulphur, alum, coal, peat, lignite, rock salt and salt springs—remain in the surface owner. In Saxony the surface owner has the right to work coal and lignite also. The larger proportion of Germany (roughly about nine-tenths) is subject to the Mining Law of Prussia.

(4) Austria-Hungary.—Under the Austro-Hungarian law the State reserves all rights in connection with such minerals as are capable of being used as metals, sulphur, alum, salt (a State monopoly), graphite, bitumen, and all kinds of coal and lignite. All other minerals—e. g., limestone, etc.—belong to the surface owner.

(5) Spain.—A good deal of legislation in respect of minerals has been passed in Spain during the last century. Minerals are divided into three groups: (a) Substances of an earthy nature—e. g., slate, stone, sand, clay, lime; (b) alluvial deposits—e. g., iron ore, peat, saltpetre, phosphate of lime, china clay, etc.; (c) all metalliferous substances, anthracite, coal, lignite, petroleum and mineral oils, graphite, salts, sulphur and precious stones.

In theory the ownership of all minerals lies in the State, but of the above groups the first and second are granted to the surface owners, the third class only being subject to special mining laws, the ownership being vested in the concessionnaire. Where the minerals of the second class are not worked by the surface owner they are made the subject of concession, subject to compensation to the surface owner.

(6) Japan.—The system of private ownership of minerals has never been in vogue in Japan. There State ownership and State control have always been exercised. For our purposes it will be sufficient to trace, very briefly, the recent legislation on the subject only.

Under the Japanese Mining Law of 1873, the State granted concessions to work minerals for periods of 15 years. As this was found to hamper seriously the mining industry of Japan, this law was amended in 1890, although the operation of the new law only came into force in 1892. This definitely established the right of permanent exploitation. The Mining Law now in force was promulgated in 1905, but it consists mainly of a rearrangement of the regulations of the previous mining laws.

Until 1900 the right of working mines in Japan was confined exclusively to Japanese subjects. Now foreigners may, subject to the existing laws, obtain concessions and work minerals.

The principal minerals recognized by the Japanese Mining Law are as follows: Gold (alluvial gold is excluded), silver, copper, lead, bismuth, tin (stream tin is excluded), stibium, mercury, zinc, iron (magnetic sands are excluded), iron sulphides, manganese, tungsten, molybdenite, arsenic, phosphate, graphite, coal, lignite, petroleum, asphalt, sulphur and natural gas.

References.—Report of the Royal Commission on Royalties, 1893. (It should be noted that many changes, some of which are important, have taken place in some of the countries investigated by this Commission.)

The author has had the good fortune to have been able to refer to special publications dealing with mining legislation issued, in most cases, by the countries in question. These are too numerous to mention here, but the Year Books of the several Colonies may be consulted; for example, the Year Book of the Australian Commonwealth.

Platinum †

By Staff, U. S. Bureau of Mines.

Physical Properties: Platinum is a white metal with a grayish tinge, and takes a high polish, but one less brilliant than silver. It is very malleable and ductile, and can be rolled into thin sheets and drawn into fine wire. These properties are impaired by the presence of impurities. It has a specific gravity of 21.3 and a hardness of 4 to 5, being harder than copper, silver, or gold. It melts at about 1,710 degrees C. The atomic weight is 195.2.

Chemical Properties: Platinum is not acted on by dry or moist air even when heated to high temperature. It is not attacked by hydrochloric, nitric, or sulphuric acid, but when alloyed with silver, copper, lead, zinc, and some other metals, it is partly dissolved by nitric acid. At high temperature it is attacked by fused alkalies in the presence of air and by potassium and other nitrates when air is excluded. It is also attacked at high temperature by carbon and by silica in the presence of carbon. Platinum vessels should, therefore, never be heated in contact with solid fuel. Cyanides likewise attack it.

Uses of Platinum: Owing to its resistance to the action of acids and most chemical agents even at high temperatures, and to its high melting point, it is in extensive use for the manufacture of crucibles, basins, foils, wire, etc., and for chemical laboratory work. A large quantity is also used in the construction of apparatus* for the catalytic manufacture of concentrated sulphuric acid. A considerable amount is consumed in the electrical and dental industries and in the preparation of salts, notably the chloride for photographic work. There has been also a large demand for jewelers.

Alloys and Substitutes: The making of alloys of platinum and substitutes to take the place of platinum has been seriously studied and to some extent platinum has been replaced. There is no question that other combinations or substitutes will be developed in the future, but no substitutes to take the place of the platinum for contact points in magnetos and for numerous other purposes has so far been found. Alloys of gold and palladium, which cannot be told from platinum by ordinary physical properties, are now used in dentistry, jewelry and to a limited extent in chemical apparatus.

Ores of Platinum: Platinum occurs native in alluvial deposits derived from the disintegration of primitive rocks in the forms of grains approximately spherical but less often flattened. Nuggets of large size are rare, but a number of small nuggets are found in the Ural district, and one weighing 270 ounces is recorded by Hautpick as having been found in the placers of Mt. Katchkonara, in the northern portion of the platiniferous district of the Urals, Russia. A still larger one, weighing 21.64 pounds is in the Demidoff Museum, St. Petersburg. The most extensive deposits of platinum are the alluvial sands of the Urals. They are contained within a length of about 80 miles along the central part of the chain in the Government of Perm, the principal centers of the placers being at Blogodat, on the eastern and Nijni Tagilsk, on the western slopes. This field furnishes the main part of the world's production of the metal. In Columbia, on the Condoto and upper Atrato Rivers, are important platinum deposits which are attracting considerable attention at this time, and the production of platinum from Colombia is steadily increasing. Platinum is associated in the placers chiefly with gold, iridosmine, chromite, magnetite, zircon, ilmenite, corundum, and quartz. The admixture of gold is variable, ranging from 2 to 3 per cent in some districts to as much as 75 per cent or more in others. Among the platinum minerals are iridium, palladium, rhodium, etc., which are intimately combined with platinum and can be separated or determined by careful chemical analysis.

Occurrence: The mother rocks of platinum are basic igneous rocks, peridotite, pyroxenite, and dunite. The peridotites and pyroxenites are dark-gray to black heavy rocks composed principally of black or dark-green iron magnesium silicates, pyroxene, augite, hornblende, olivine, plagioclase feldspar, chromite, ilmenite, and magnetite. Dunites are composed principally of olivine with some chromite. There is every gradation between these types of rocks and the less basic rocks. A characteristic of the basic rocks is their tendency to alter to serpentine, a soft, greasy fibrous mineral of olive-green to black color that

† This information was issued by the U. S. Bureau of Mines, in response to numerous inquiries. In preparing it a number of authorities have been consulted, the publications of James M. Hill, of the Geological Survey, having been especially drawn upon.

once seen is readily remembered. Attempts to trace platinum to its source have proved successful in Russia, Spain, and Canada, but no deposit of platinum in the mother rock has been found of commercial grade under normal conditions. It is possible, but does not seem probable, that bodies of platiniferous rock may be found in the United States rich enough in platinum to be worked under present conditions. It should be recalled, however, by all persons searching for platinum ores, that the assay for platinum is difficult and apparently cannot be successfully made by all commercial assayers. It is, therefore, strongly recommended that samples of supposed platiniferous ores be sent only to most reliable analysts.

Black Sands: Most of the platinum produced in the United States is recovered as a secondary mineral from placer operations and from the electrolitic refining of gold bullion and blister copper. From time to time the beach sands of Oregon and Northern California have been exploited by promoters on the basis of the gold and platinum content. A successful method of mining these sands must be based upon a thorough prospecting of the deposits. Investigation has shown that in general the black sand deposits are disappointing in both quantity and quality, and while in a few places there has been sufficient surface concentration to permit of small mining operations, these deposits rarely contain enough gold and platinum or occur in adequate extent to be operated at a profit.

Metallurgy: In general, the crude platinum of the western placers is found in relatively small scales or flakes, some larger than one-eighth inch in diameter, but the majority less than one-sixteenth inch in size, many being under one thirty-sixth inch. The saving of platinum by the ordinary methods of placer mining is carried in suspension to the tailing piles. Undercurrents in the sluice lines have added to the saving of the fine gold but they are not entirely satisfactory as savers of gold and platinum. Burlap and canvas tables have also been used with some success. Many types of specially designed machines have been tried and discarded, though undoubtedly some have merit and a few are making fairly satisfactory saving. In the treatment of beach sands concentrating tables are also used.

The loss of fine gold and platinum in ordinary hydraulic operations is due to several causes, among which may be mentioned running pulp too fast and agitating it too much to permit settling, failure to clean up often enough to prevent packing of riffles with consequent formation of smooth slopes over which metals readily flow under pressure, and failure to provide settling boxes for fine material carried in suspension. On some of the gold dredges various devices to effect a closer saving of the fine gold and platinum lost in the tailing have been tried. The most successful has been the Neill jig-Hardinge mill plant, which is in operation on two of the Natoma dredges in California. It was found on some of the other dredges of this company and of other companies in the state that the recovery effected by this tailing plant was not sufficient to justify the expense of its installation. In other words there was very little platinum or fine gold in the tailing. In addition to the platinum recovered from placer operations, some platinum and palladium is recovered from the platiniferous ores of the Boss Mine, in Nevada, and the Rambler Mine, in Wyoming. These ores are concentrated locally and sent to refiners for final treatment. The United States Smelting and Refining Co., and the Irvington Smelting Works buy ores. The crude platinum is separated from the sands and gravels, as already stated, by a series of washing processes. If any gold is present it is obtained in the concentrate together with the platinum. In Russia the gold is removed by repeated amalgamation with mercury in wood, iron, or porcelain bowls, about 10 to 30 pounds being treated at a time. The crude platinum is then almost all exported to be refined abroad, not more than about 2 per cent being refined in the country.

Refining: The "crude" platinum can be refined either by dry or by wet methods. When dry methods are employed, any iridium or rhodium present will remain with the platinum; on the other hand, when wet methods are used, the resulting platinum will be pure. A combination of the two methods is also employed. The wet method consists essentially in dissolving the crude platinum in aqua regia, precipitating the platinum as ammonium platinichloride, heating the precipitate to redness, forming spongy platinum, and fusing the latter by the oxyhydrogen blowpipes in a furnace constructed of blocks of lime. The refining of platinum ore is a complicated matter.

The principal buyers of crude platinum in the United States are the following firms:

American Platinum Works, Newark, New Jersey.

Baker & Company, Newark, New Jersey.

Belais & Cohn, 13 Dutch Street, New York City.

Bishop & Company, Malvern, Pennsylvania.

Pacific Platinum Works, Los Angeles, California.

Shreve & Company, San Francisco, California.

H. A. Wilson Company, Newark, New Jersey.

S. S. White Dental Company, Philadelphia, Pennsylvania.

Hints for Prospectors: The placer deposits containing platinum are all, so far as known, in the vicinity of areas of basic igneous rocks, and in any search for new deposits of platiniferous gravels the first step is to find outcrops of peridotite, pyroxenite, dunite, and serpentine. When these have been found, the gravels in streams flowing out should be washed to ascertain if platinum is present. The heavy concentrates found in gravels carrying platinum are usually rich in chromite and olivine. The character of the rock particles often gives a clue to the source from which the gravels were derived. Platinum as it occurs in placer concentrates, is ordinarily a silvery-white metal which could be confused only with silver and possibly pieces of iron or steel. It can be distinguished from both of these metals, as they are soluble in dilute nitric acid; crude platinum can be dissolved only in concentrated aqua regia, a mixture of 3 parts of hydrochloric (muriatic) acid and 1 part of nitric acid. In some placer deposits the grains of platinum are coated with a dark film and somewhat resemble the grains of the dark minerals chromite, magnetite, or ilmenite, from which they are separated by careful panning, as the specific of platinum is greater than that of any of those minerals.

Platinum will not amalgamate with quicksilver alone, but will amalgamate if sodium is added. In ordinary quicksilver and amalgamation the flakes of platinum float on the surface and can be removed. If sodium amalgam is used, the platinum may be separated from gold by agitating the amalgam with water until all the sodium is used up to form sodium hydroxide; then the platinum will come out on the surface of the amalgam, provided, of course, the amalgam is sufficiently liquid. Platinum can be scratched with a knife. It is so malleable that it can be pounded without heating into very thin sheets. It is practically infusible; the grains cannot be melted together as particles of gold can.

A relatively simple chemical test can be made to determine platinum. The metallic particles are dissolved by boiling in concentrated aqua regia and allowing the resulting solution to remain on the stove 'till dry. The residue is dissolved again in hydrochloric acid and evaporated by boiling till the solution is thick but not quite dry. This mass is dissolved in distilled water and a few drops of sulphuric acid and of potassium iodide solution are added, which, in the presence of platinum, causes the solution to turn a very characteristic wine-red, if much of the metal is present, or to a reddish-pink in the presence of small quantities of platinum. The test outlined above is fairly delicate, but it cannot be used to detect traces of platinum in the presence of large quantities of iron or other elements.

A second test may be applied to the aqua regia solution after the re-solution in hydrochloric acid outlined above. In this test potassium chloride (KCl) is added to the solution, which precipitates yellow crystals of potassium platinic chloride (K_2PCl_6), if platinum is present.

A third test may be applied. Add ammonium chloride (NH_4Cl) to the aqua regia solution, which will precipitate yellow crystals of ammonium platinic chloride, if platinum is present.

The precipitates from tests 2 and 3 are both insoluble in alcohol but are soluble in water and may be reduced to platinum sponge by heating.

All these tests are comparatively simple and positive when made on single grains, but they cannot be relied upon when various other elements are present in the material tested. It is, therefore, recommended that their use be restricted to grains of a single mineral picked from the concentrates obtained by panning a sample of either rock or gravel.

Price: The price of platinum has been fixed at $105 an ounce, iridium $175 an ounce, and palladium $135 an ounce, by the United States Government. These prices are subject to change and regulation by the War Industries Board. A joint committee of the Bureau of Mines and the War Industries Board have formulated rules and regulations for the sale and distribution of platinum, copies of which may be had by writing to the Platinum Section, War Industries Board, Washington, D. C., to which all inquiries should be addressed regarding the sale of platinum of any description.

Dry Classification of Granular Material

By William E. Bryan.*

The mechanical classification of dry granular material is the result of the action of several natural laws. These must operate in conjunction with a mechanical device so arranged as to permit the balancing of the action of the various principles involved and at the same time placing the relative acton of the dry granular material completely under control of the mechanical device.

Laws Involved.

The first active law in mechanical sizing is termed the law of selectiveness, i. e., that the mixed particles of various sizes of granular material, when under agitation upon a level plane, the finer particles sink to the bottom and engage the surface, while the coarser particles rise to the top without regard to the specific gravity of such particles.

The second active law is called the law of displacement or the displacement of the centers of gravity of particles upon an inclined plane. The relative difference in the tendency of coarse and fine material of granular shape, to move down in inclined plane is due to the difference in the displacement of their centers of gravity upon the same angle of plane.

The third active law is the law of friction of mass or the "coefficient of friction."

Mechanical Apparatus.

Close observation of the action of these laws as well as the influence of other forces has led to the design of a mechanical device simply arranged to best meet the requirements of these laws. In order to assist the law of selective action on an inclined plane, a series of several hundred tapered riffles or grooves are placed on the inclined surface of what is termed the deck of the device. This permits the "fines" to sink to the bottom of these grooves and forces the discharge of larger particles over the top of the riffle, in acordance with the action of the law of displacement of centers of gravity. This is accomplished by the feeding of dry material to the inclined deck while the same is being agitated forward and backward by a specially designed head motion, which pushes the deck forward at one speed and causes it to return at a higher speed. This sets up what is termed a progressive action of material on the deck or causes the granular particles to travel in a forward direction, under the government however, of the law of selective action and the law of displacement aided by the law of friction of mass.

Under operation, the device is fed with dry ore, sand, grain or the like, the feed engaging a feed board where a preliminary rough separation is accomplished by a modified application of tapered riffles. The feed then engages the table deck at the head of its proper zone and here, because of the length and the great number of riffles, almost any desired number of carefully sized products may be taken off by replacing receptacles at the bottom and far edges of the deck, from which falls, when in action, a constant sheet of granular material graded carefully from coarse particles to fine dust.

Range of Application.

Mechanical sizing is applicable to every form of dry granular material such as crushed ore, salt, coal, sand, emery, cereals, unbroken or crushed, or in fact, there is no field in dry sizing now filled by metallic screen devices that cannot be filled by a mechanical sizer and often with greater economy and efficiency. This is proved by the fact that metallic screens blind and lose their efficiency, while the mechanical device cannot clog or blind and automatically cleans itself.

Specific gravity has practically no effect upon mechanical sizing for the reason that granular particles of the same contour and volume, when placed upon an inclined plane, have the same displacement of their centers of gravity with the result that a particle of lead and a particle of sawdust of the same size and shape will discharge from the table at the same point, although the specific gravity of the one is many times that of the other.

* General Manager, The Minerals Recovery Co., Denver, Colorado.

General Summary of the Petroleum Situation*

J. O. Lewis.

There is at the present time a world-wide interest in the oil situation. This has been induced as a result of the war calling attention very strongly to the need of petroleum and its products both in a military and commercial sense. These products are principally: Gasoline for automobiles, farm tractors, trucks, aeroplanes, motor boats, etc. Fuel oil for marine propulsion, metallurgical processes, and internal combustion engines of the Deisel type; and lubricants for all machinery, for which there is no satisfactory substitute quantitatively known. As a result there is great commercial and political interest in petroleum. The British and French governments have taken very strong and active stands in adopting programs towards acquiring sources of supply, and in protecting their nationals within their domains and spheres of influence. Commercially there has been a tremendous interest both in Europe and in the United States. This interest has taken the direction of the formation of consolidations backed by large capital and explorations both at home and abroad, and the usual side growth of such movements—the formation of many ill-conceived and dishonest promotions in which the public has invested extensively.

Development in the United States is very active. The prices of crude oil have remained practically constant since the entrance of the United States into the world war, but the future is generally considered so promising commercially by the industry that every effort has been made towards finding new fields and bringing oil fields to a high stage of development has received very wide recognition and prospecting for oil is conducted almost entirely by the large companies upon geological advice. At the present time the chief center of interest is the Palezoic belt in Texas and the Cretaceous formations in Wyoming. Prospecting is, however, going on extensively in Louisiana, Arizona, New Mexico, Utah, Montana and other States.

At the present time the principal domestic source is in the Mid-Continent field which extends from Kansas through Oklahoma into northern Texas and Louisiana. This district is producing now more than a half million barrels of oil daily, being more than half of the total production of the United States. This oil averages above the rest of the country in quality and the proportion of gasoline obtained from this district is between 60 percent and 70 percent of that obtained from the total production of the United States. The production of Oklahoma has declined slightly, and that of Kansas has declined greatly since last year, while the production in Texas, particularly in the Palezoic zone, has largely increased over that of last year, with a present daily production of close to 300,000 barrels. The oil from northern Texas is of an especially high grade, and contains a high percentage of gasoline. The prospects are for extending the production considerably in Texas. At the present time the Texas district is supplying our increased needs for gasoline and other products.

In California considerable new territory of great promise has been recently developed in the southern part of the State and in the Elk Hills District in Kern County. The latter district is on a geological structure of great size that formerly had been practically condemned, through misunderstandings of the proper drilling methods in such territory. The district is, however, closed to public entry except in a small part, by reason of the establishment of the Naval Reserve and litigation over railroad lands.

During 1918 some thirty-eight million barrels of oil was imported from Mexico. Imports have been greatly increased during the first half of 1919, and they can be still further extended, according to the need of the United States, as it is chiefly a matter of demand and transportation. A great deal of interest is being displayed in establishing refineries on the Gulf Coast of the Atlantic seaboard to handle Mexican oil, the intention being to export Mexican oil and take off the gasoline and other desirable products, selling the residuum for fuel oil. Refineries for this purpose are being established as follows (figures show initial daily capacity):

* Excerpts from Monthly Reports of Minerals Investigations, U. S. Bureau of Mines.

Atlantic Refining Co.	Brunswick, Ga.	3,000 barrels
Standard Oil Co. of New York	Providence, R. I.	....
Mexican Petroleum Co.	Baltimore, Md.	....
Standard Oil Co. of New Jersey	Charleston, S. C.	7,500 barrels
Standard Oil Co. of Ohio	Toledo, Ohio	10,000 barrels
Roxana Petroleum Co.	New Orleans, La.	....
Crown Oil & Refining Co.	Houston, Texas	5,000 barrels
Ohio Cities Gas Co.	Newark, Ohio	3,000 barrels
Sinclair Gulf Corp.	Houston, Texas	5,000 barrels
Evans-Thwing Refining Co.	Fort Worth, Texas	5,000 barrels
Union Oil Co.	San Pedro, Calif.	10,000 barrels
Humble Oil & Refining Co.	Houston, Texas	10,000 barrels
Inland Refining Co.	Fort Worth, Texas	5,000 barrels

In regard to the petroleum products: Gasoline has remained practically stationary in price during the last two years, with the local tendencies towards cuts in prices; kerosene has increased in price; fuel oil, since the signing of the armistice, has decreased very greatly in price and its disposal at the present time constitutes the most serious problem in the refinery business east of the Rocky Mountains. There has been a considerable decrease in the price of crude oil in the Gulf Coast fields where the oil is of low gasoline content, also in the price of Mexican crude oil and for fuel oil distillate from the eastern refineries. Active steps are being taken to establish a wider market for fuel oil, and it is at the present time competing very actively with coal for steam generation along the Atlantic seaboard, particularly in New England. It is anticipated that the completion of the refineries for handling Mexican oil on the Atlantic seaports will induce still stronger competition with coal in our seaports.

During the late summer and winter of 1918 the stocks of gasoline became reduced to a dangerous minimum. These have been building up during 1919 as a result of increased production and the readjustment since war conditions. The daily average production of gasoline during the month of May was, in 1917, 7,703,749 gallons; in 1918, 10,302,942 gallons; in 1919, 11,434,593 gallons. Stocks have increased from 460,637,479 in May, 1918, to 594,035,688 in May, 1919. Kerosene stocks have, however, decreased greatly, from 343,000,000 gallons to 245,000,000 gallons. Gas and fuel oil stocks have increased from 515,000,000 to 789,000,000 gallons.

WATER-POWER RESOURCES OF THE UNITED STATES.

The United States Geological Survey, Department of the Interior, has prepared a map showing by states the distribution of the water-power resources of the United States in horsepower per square mile. On this map the relative potential water-power resources of each state are indicated by shading in one of six symbols, and the average horsepower of the state per square mile is shown by numbers. This average ranges from 6.2 horsepower per square mile for the State of Florida to 125.0 horsepower per square mile for the State of Washington. The shading indicates at a glance the parts of the United States in which water-power resources are most abundant.

The information given on the map was compiled from a census of the potential water-power in the United States, prepared by the United States Geological Survey in 1908 and revised and published by the Department of Agriculture in Senate Document 316, 64th Congress, 1st session, entitled "Electric Power Development in the United States, 1916." The figures used show the maximum horsepower, which is here defined as the amount of power that is available for six months of the year.

Copies of the map may be obtained from the Director of the United States Geological Survey, Washington, D. C.

Interesting Application of Heat.

A recent issue of the **General Electric Review** describes a method of heat shrinking for fitting part of electrical machines on to their shafts. The method overcomes various difficulties experienced with press fittings. Water or steam heating is used for flywheels and couplings, while for armatures and field systems, conveniently situated heating resistances answer the requirements. In one case mentioned, i. e., a large armature, the shaft was 35 inches in diameter. Cold pressing would have required a maximum pressure of 600 tons. By heating the armature to about 80 degrees C., however, the shaft could be pulled in with a five-ton chain hoist.

DISCUSSION

ONE-MAN SURVEYS.

Sir—I wish to make a few comments on the article entitled "One-Man Surveys" by George O. Marrs, which occurred in the October, 1919 issue of the magazine.

Every man has his own methods, which are, as a rule, or at least should be, suited to the kind of work that he is doing. The methods used in one district may not be suited to another district. While it is admitted that triangulation may be more accurate than ordinary traversing, it undoubtedly takes more time or at least takes more time than ordinary work warrants. The writer has had many traverses of several miles close within 1:8000. In making these traverses no nails were used on the stakes and the chainmen employed were middle-aged men with no previous experience in surveying. The results were obtained time and time again, day after day, during the summer in one particular district.

The chief of the "one-man survey" in this particular work would have had many weary climbs up and down cliffs to set his points and while the results might possibly be better and more accurate, increased accuracy in this particular case was hardly necessary or desirable.

In underground work the writer has as a rule difficulty enough in getting a line down a shaft or winze without adding to this the troubles of triangulation. In many of the shafts with which the writer is familiar a set-up has to be made, on brackets, between levels. While in some cases this might possibly be done by triangulation, it would take more set-ups, and set-ups are to be avoided in underground work not sought after. The writer has also found that by using the same methods throughout a survey better results are usually attained, especially where others make the subsequent calculations.

It should also be remembered that chainmen are cheaper than surveyors, in fact, one can usually get at least three helpers for the price of one surveyor. It hardly seems right for the engineer to spend his time doing what cheaper men could easily do as well. An engineer would seem to be cheapening himself by doing chainman work. In underground work especially, the instruments, lamps and other impedimenta required are usually more than one man can carry, and a helper is therefore needed.

Then, too, any surveyor is liable to have to go into court as a witness and his survey may be valuable evidence. A triangulation survey might convince a judge and probably would, but it would be difficult to get its advantages through the heads of an ordinary jury. Again in court work the helpers might be valuable witnesses.

JAMES UNDERHILL.

REPORT OF THE ELIGIBILITY COMMITTEE APPOINTED BY THE ROCKY MOUNTAIN FACULTY ATHLETIC CONFERENCE.

Your Committee, pursuant to instructions, has investigated the rumors current relative to the eligibility of certain members of Conference teams and report that they have found the same without foundation in fact.

Your committee further recommends that its findings be sent to the Faculty Representatives of the Colorado Institutions with instructions that the same be given publicity among the students.

Your committee further reports that, during the course of its investigations, it found that proselyting among athletes had been countenanced by certain Colorado institutions. This practice your committee finds is provocative of ill-feeling among the several Institutions and for that reason your committee recommends that the Rocky Mountain Faculty Athletic Conference take immediate steps to prevent the repetition of the same.

The committee consisted of the following:

J. W. Woodrow, University of Colorado. Chairman.

N. C. Morris, Colorado College.

C. H. Wigender, Denver University.

W. E. Burlingame, Colorado School of Mines.

Bernard Seaman, University of Colorado.

H. W. Yersin, State Agricultural College. (Not present at meeting.)

Many thousand dollars' worth of diamonds and sapphires are used every year for bearings in electric house meters.

TECHNICAL REVIEW

GENERAL.

The Premier Gold Mine, Portland Canal, B. C. By Charles Bunting. (Mining & Scientific Press, November 8, 1919.)

Much has been written about the Premier mine situated near the head of the Portland Canal, which, while interesting, is at variance with the facts. The writer is well acquainted with the property, its ore-bodies, values and history, and will briefly review the facts relating to the above and indicate the immense possibilities of this remarkable mine.

G. V. DUNN.

The United Eastern Mill at Oatman, Arizona. By Wheeler O. Worth. (E. & M. J., October 11, 1919.)

The United Eastern Mining Company's property is situated in the Oatman Gold Road Mining District of Mohave County, Arizona. The mine and mill are about twenty-six miles southwest of Kingman, the nearest railway point. The ore consists of a mixture of calcite and quartz, with some andesite. The ore is mainly gold, alloyed with approximately 34 per cent. by weight, of silver, are extremely fine, so that fine grinding is a most important factor in extraction. The milling process, briefly, consists of single stage, coarse crushing, two-stage ball milling in cyanide solution, followed by combined mechanical and air agitation and by straight counter-current decantation. The Merrill zinc dust precipitation method is used. This is preceded by the Crowe vacuum treatment of the solution.

The most notable features of the plant are the absence of filters, and the use of short ball mills for grinding.

As this paper deals primarily with plant operations, those interested in the mechanical description are referred to the article of Otto Wartenweiler, the designing engineer, which gives the details and costs of design and construction.

G. V. D.

Ore Deposits of Utah—Part I. By B. S. Butler (U. S. Geological Survey, Washington, D. C.). (E. & M. J., October 11, 1919.)

The object of this paper is to present a summary of some of the features of the ore deposits of Utah that are discussed in greater detail in a report now in press on the "Ore Deposits of Utah," U. S. Geological Survey, Professional Paper III, by B. S. Butler, G. F. Loughton, V. C. Hughes, and others. For a more complete account of the geology, description of individual districts, for references to the extensive literature and other features, the reader is referred to this report.

G. V. DUNN.

British Columbia. (Mining & Scientific Press, October 18, 1919.)

Labor troubles have closed down operations on three of the most important of British Columbia's metal mines. Two of these are situated in East Kootenay, namely, the Sullivan mine, owned by the Consolidated Mining & Smelting Co., of Canada, and the North Star mine, Kimberley, which has been shipping regular to the Trail Smelter. The third is the Nickle Plate mine, owned and operated by the Hedley Gold Mining Co. The Hedley mine was the greatest producer of gold in British Columbia for years, until the Surf Inlet mine began operating on a considerable scale two years ago.

G. V. D.

Mining and Smelting near Monterrey, Mexico. By R. B. Brinsmade. (Mining and Scientific Press, November 22, 1919.)

The City of Monterrey, capital of the State of Nuevo Leon, is situated at an altitude of 500 metres above sea level, and only 150 kilometres from the Rio Grande. Its low altitude gives it the climate of Southern Texas rather than that of the Mexican plateau, which usually exceeds 1,500 m. in elevation, and its propinquity to the border makes it the most American in appearance and population of all the large Mexican cities, leaving the city with its well-paved streets, its handsome business blocks and residences, and its extensive smelting industry. We need go only twelve miles out of town on a narrow-gauge railway to reach the extensive lead mines of the Cia-Metalurgica Mexicania at the village of Diente.

G. V. D.

Short Cuts in Mine Surveying—I. By Douglas Waterman. (Mining & Scientific Press, November 22, 1919.)

The aim of these articles is to furnish a few practical notes on the choice and use of surveying instruments, and to point out how many of the problems which arise in every-day practice may be treated in a simple yet satisfactory manner.

G. V. D.

METALLURGY AND ORE DRESSING.

The Cananea Ore-Bedding System. By G. W. Price. (Mining & Scientific Press, November 8, 1919.)

This plant was commenced and partly installed under the management of Arthur S. Dwight in 1905, completed and placed in operation by L. D. Ricketts in 1908. The details of this system were worked out by E. H. Messiter, consulting engineer for the Robbins Conveyor Belt Co. The object is to secure perfect mixture of the blast-furnace charge, and at the same time provide a considerable storage. This system, the first of its kind, has been in operation for ten years, except such time as revolutionary troubles have closed the smelter. G. V. D.

The Hornet Crushing Plant. By Lloyd C. White. (Mining & Scientific Press, November 1, 1918.)

Reference has recently been made to the large deposits of sulphide ore in Shasta County, Calif. The following notes have to do with the methods of preparing the pyritic ore for the market as applied by the Mountain Copper Company in the exploitation of the Hornet ore-body.

G. V. D.

OIL.

Possibilities of the Oil-Shale Industry. By H. M. Roeschlaub. (E. & M. J., Oct. 4, 1919.)

There are many articles on the oil-shale industry, but only a very few really tell you much about its possibilities. It is a well-known fact that there is a large amount of shale which, upon distillation, will yield oil, but, as yet, not in commercial value. The quantity and quality has been written about so much that we almost know it by heart. What the people want to know is how to go about to distill this shale bearing the oil.

The author gives a very good description of the fundamental principles of destructive distillation or retorting. Without a knowledge of the basic principles of distillation we can never hope to obtain results. There is a great deal of work at present being done on this subject, but hardly a word has been said among the technical men because they cannot prove decisively what they believe to be correct.

The articles treat the following subjects in a brief but concise manner:

1. Scotch shales.
2. United States shales.
3. Oil contents and value.
4. Physical conditions.
5. Destructive distillation.
6. Permanent gas.
7. Crushing.
8. By-products.
9. Flotation.
10. Fertilizer.
11. Precious metals.
12. Refining.
13. American methods. F. A. L.

The New Kick Under-reamer—A California Invention. (The Petroleum Times, October 11, 1919; no author).

Mr. William M. Kick, a well known drill contractor of Coalinga, has been awarded a patent for a new under-reamer for reaming well below the bottom of the casing, and more particularly for use in combination with drill-bit.

The object of the invention is to provide an under-reamer of such construction that comparatively little wear can occur at any point except the cutting or reaming edge of the cutter member which may be easily removed or replaced.

The article is accompanied with a drawing and a complete description of each part. F. A. L.

Refining Petroleum. By J. W. Coasta, Jr. (The Doherty News, October, 1919.)

This article describes the refining methods of the Empire Refineries. It not only describes the methods used, but also the principles involved. The process is little used by other refineries, but is gradually coming into rapid use. Its object is to increase the yields of gasoline by "cracking" or converting the low-priced gas oil into gasoline and kerosene. This is done by high temperatures and pressures. It is one of the newest processes and is still in its early stages of development.

Various sketches are used to explain the operation of the many different pieces of equipment used in the refining of petroleum. F. A. L.

INDIANS FIRST SALT MERCHANTS IN THE UNITED STATES.

The Delaware Indians made salt from brine springs in New York State and sold it to settlers as early as 1670, making probably the first commercial production of salt in this country. The manufacture of salt by white people in the United States was begun near Syracuse, N. Y., about 1788. Salt is the most commonly used mineral in the world, and no useful mineral except coal, perhaps, occurs in greater abundance or is more widely distributed in the United States.

PERSONALS

Dr. Victor C. Alderson represented the School of Mines at the American Mining Congress Convention at St. Louis. He was appointed chairman of the oil shale section.

'95.

F. S. Titsworth's present address is 29 Waverly Place, New York City, N. Y.

'00.

Edwin H. Platt is now at Molina, Colo.

Ambrose E. Moynahan is general manager of the Louisiana-Colorado Mining Co., Alma, Park County, Colorado, and also engineer in charge of the Reserve and Kenneber Gold Mining Companies.

'01.

Winfred A. Pray is now the owner and director of the Newlands Irrigation District at Fernley, Nevada.

'02.

C. T. Barron is now manager of the Norfolk Smelting Co., Inc., at West Norfolk, Virginia.

'03.

H. G. Palsgrove, superintendent of the Avalos Unit of the Minerales y Metales at Zacatecas, Mexico, has returned to Denver because of the danger from bandit activity.

William L. Fleming has offices at 50 Broad Street, New York. He is in the brokerage business.

C. A. Liddell has offices at 410-411 State Bank Building, Tonopah, Nevada, where he is engaged in U. S. Mineral Land Surveying and general examination work.

'04.

Charles (Spike) Adams is with the Pacific Electric Co., Los Angeles, Calif.

Wallace Lee is now associated with the Frantz Corporation as an oil geologist. Address Freiderich Building, Denver.

Scott H. Sherman, manager of the Gila Copper Sulphide Co., of Christmas, Arizona, has resigned. He has taken up residence at Phoenix, Arizona.

'08.

Karl G. Link is with the General Petroleum Co., Box 185, Vega, Oldham Co., Texas.

Captain Gary E. Block has returned from France and is again with the Ellsworth Coal Co., Globe Building, Pittsburg, Kansas.

S. C. Sandusky has accepted a position as assayer and surveyor with the Nevada Packard Mines Co., at Lower Rochester, Nevada.

'10.

F. A. Goodale has gone to Queensland, Australia, to examine some gold and sapphire placers. He expects to be gone from Colfax, California, about four months.

Dana W. Leeke has returned from the Orient and is enjoying a well-earned vacation at his home in Upland, California.

'11.

R. G. Bowman is chief testing engineer for the International Smelting Co. at Tooele, Utah.

Archer T. Spring is a geologist for the Roxana Petroleum Co. Address Box 930 Cheyenne, Wyoming.

'12.

Henry M. Roberts has returned from France and is again associated as secretary with the J. Fred Roberts Construction Co., 206 Tramway Building, Denver, Colorado.

Wilfred Fullerton is on a holiday at his home, 1208 Sherman Street, Denver, Colorado.

A. L. Toenges has accepted a position as resident engineer with the Western Coal & Mining Co., Pittsburg, Kansas.

W. G. Ramlow is permanently located at 1377 Selby Avenue, St. Paul, Minn.

Charles D. Heaton is manager for the American Rare Metals Co. at Egnar, Colorado.

'13.

Harold C. Price has been transferred from the American Zinc & Chemical Co. at Langeloth, Pa., to the Bartlesville Zinc Co. at Bartlesville, Oklahoma.

Richard A. Leahy, who served as a First Lieutenant in the Royal Flying Corps, has returned from England and is now associated with W. A. Butchart, manufacturer of ore-dressing machinery, 1326 Eleventh Street, Denver, Colorado.

S. E. Watson is with the Anaconda Copper Mining Co. Address, 511 Cherry Street, Anaconda, Montana.

Mearle W. Wilkinson is in charge of the laboratories of Wilkinson & Co. of Los Angeles, California. Home address, 1338 Sixth Street, Santa Monica, California.

Merwyn S. McGregor is in the automobile business at Santa Barbara, California. Address, 1335 Bath Street.

Herman W. Hugo is still a patient at the Oakes' Home, 2825 W. Thirty-second Avenue, Denver, Colorado. We wish some of our alumni members in Denver would visit him. Visiting hours in forenoon only.

'14.

Robert H. Harper is a member of the firm "Harper & Sons," 303 Fleming Building, Des Moines, Iowa.

'15.

Allan H. Graham assisted Messrs. P. G. Harrison and T. R. Hunt, geologists for Utah Consolidated, in their suit against the Utah Apex at Bingham Canyon, Utah.

'16.

W. M. Traver has been transferred from the Denver office of the Empire Zinc Co., at Gilman, Colorado.

'17.

Norman E. Maxwell has joined the engineering staff of the Phelps-Dodge Corporation at their Burro Mountain Branch, Tyrone, New Mexico.

'18.

Thomas H. Allan is at Kimberly, Nevada, with the Consolidated Copperminès Company.

'19.

Blair Burwell has accepted a position as engineer for the Standard Chemical Co. at Naturita, Colorado.

Wm. A. Charles has gone to Elko, Nevada, where he has accepted a position with the R. M. Catlin Oil Shale Co.

EX-MINES NOTES.

'98.

Murray Lee is located at Wheatridge, Colo., R. F. D. No. 1.

'06.

E. F. Franck has gone into the "Movie" business at Ajo, Arizona.

'10.

Thos. M. Skinner is located at Douglas, Wyoming.

'14.

R. G. Bohn is assistant chief operating engineer for the Illinois Traction System. Address, 611 Linn Street, Peoria, Illinois.

'15.

Bertram Grant is with the General American Tank Car Corporation at their East Chicago, Indiana, plant.

H. H. De Laittre and his bride, who was Miss Agnes Carter of Minneapolis, were visitors in Golden recently. De Laittre returned from France in May.

'16.

Willis P. Mould and Miss Ruth Frances Greene were married at St. Albans, Vermont, on September 18, 1919. Mould is engaged in iron mining at Mineville, New York.

'19.

Sergt. Neil W. Kimball has returned to Golden after serving twenty-seven months with the 319th Engineers.

OBITUARY.

Ex. '16.

It is with deep regret that we announce the untimely death of Albert E. Gregory at San Francisco, California, on November 11. Gregory had only recently returned from Hokitika, New Zealand, where he was engaged in exploration work for the Metals Exploration Co., with headquarters at 1213 Hobart Building, San Francisco, Calif. His death was caused by a tumor on the brain, which first began to manifest itself on his return voyage from New Zealand. He is survived by his wife, Mary H. Gregory, and a two-and-one-half-year-old daughter, Jane.

OXIDIZED ZINC ORES OF LEADVILLE, COLORADO.

Report Published by the Geological Survey.

Although Leadville, Colo. has been one of the most important mining centers in the country for the last 40 years and during that time has produced oxidized ores of gold, silver, and lead, as well as sulphide ores of these metals and of zinc and copper, it was not until 1910 that oxidized zinc ore was discovered there in commercial quantity. The discoverers of this ore found that the engineers who had run the old shafts and drifts had driven them through large masses of it without suspecting its character, and the engineers and geologists who had frequently examined the mines as well as the managers and superintendents who had been in the workings almost daily made some rather amusing excuses to account for their lack of perception. All, however, had to share the blame for having overlooked the ore.

More than 140,000 tons of oxidized zinc ore, containing an average of 29 per cent of zinc, was mined at Leadville in 1912. Since that year both the quantity and the tenor of the ore mined have decreased. The bodies of high-grade ore that furnished the large shipments from Carbonate Hill have been worked out, and the other bodies of equally high grade ore that have been exploited are much smaller. Extensive bodies of low-grade ore containing from 15 to 23 per cent of zinc are now being worked and will continue to furnish a considerable supply of ore for many years if the demand continues.

The oxidized zinc ores of Leadville are discussed in Bulletin 681 of the United States Geological Survey, by G. F. Loughlin, who describes the several varieties of ore and their component minerals, as well as the distribution, mode of occurrence, and origin of the ore, and makes suggestions to prospectors for ore bodies. This bulletin may be obtained free of charge by application to the Director, United States Geological Survey, Washington, D. C.

ATHLETICS

By F. A. Lichtenheld, '20.

ROCKY MOUNTAIN CONFERENCE FOOTBALL STANDING.

	Played	Won	Lost	Tied	Pct.
Colo. Aggies.....	6	5	1	0	.833
Utah University.	5	4	1	0	.800
Colorado College.	5	3	1	1	.750
Utah Aggies....	4	2	2	0	.500
U. of C.........	6	2	3	1	.400
C. S. of Mines...	4	0	3	1	.000
Denver Univ....	4	0	3	1	.000

LINDERHOLM ELECTED CAPTAIN.

Linderholm was chosen to lead the Mines football team for next year. "Lindy" played at full this year, but previously made a letter at end. He comes from Alamosa, Colorado, and we wish there were more places like it if Linderholm is one of their products.

The lettermen are: E. Bunte, captain; A. Bunte, Gibbons, Hyland, Benbow, Gallucci, Houssels, Dunn, Robertson, Schneider, Linderholm (captain-elect), Poulin, Hamilton, Clark, Haskin, Morton, and Manager Brinker.

MINES 0, D. U. 0—AT DENVER.

Fighting hard from start to finish, yet neither team was able to score. A cold wind, blinding the players and coupled with flurries of snow, made football anything but pleasant. The field was covered with a coat of snow, and fast, brilliant playing was impossible. Fumbles were frequent, Mines getting a little the best of their recovery. Time after time the Mines back field brought the ball to D. U.'s ten-yard line, only to lose it on downs by a couple of inches. The snow-covered ground made judging of yards gained or lost very difficult and the quarterback, taking no chances of losing the ball, called for a punt on their last down.

The only time Mines' goal was in danger was in the first quarter, when, with a series of plunges, D. U. put the ball on the Mines' ten-yard line, but a fumble lost it for them. After this D. U. never saw the thirty-yard line. They had their hands full defending their own goal.

The whole Mines team put up a brand of football and, on a drier field they would be hard to hold to any score.

The game was cleanly played. The time required to play the game was rather short; only twice was time called for injuries, and once or twice to give the men a chance to get their breath.

Schneider and Dunn played the best for the Mines; also Haskin, the two Buntes and Robertson. Lindholm, Finesilver and Andrews did the best work for the Ministers.

The first and second periods nearly resulted in an exchange of punts. D. U. gained first downs once in the half; Mines three times. A. Bunte did the best kicking, gaining ground on every exchange of punts.

In the third period A. Bunte kicked to Andrews on the twenty-yard line. D. U. couldn't gain, so kicked to Schneider on Denver's forty-five-yard line. Mines made first down and fumbled.

The Mines in turn recovered D. U.'s fumble and a penalty against D. U. placed the ball on their twenty-five-yard line. Here Mines carried it five yards, only to lose it on downs. A fumble by D. U. gave Mines the ball on Denver's twenty-yard line. Again the Ore Diggers failed to make their down only by a few inches.

The Mines were threatening Denver's goal, but the heavy field prevented them from getting plays started.

An exchange of punts opened the fourth period. Mines blocked Andrews' punt and Linderholm recovered it. A. Bunte tried a field goal, but the ball went wild. The Ministers opened up and made their downs for the second time during the game. They were then forced to punt.

A forward pass, Schneider to Bunte, netted twenty yards for the Mines, but another was incomplete.

Mines resorted to open football almost entirely at this stage.

Denver was held for downs and an exchange of punts followed. The game ended with D. U. having possession of the ball.

MINES	Position	D. U.
Robertson	L. E.	Graham
A. Bunte	L. T.	Geer
Clough	L. G.	Dodds
Hyland	Center	Finesilver
Benbow	R. G.	Phillips
Morton	R. T.	Lindrum
E. Bunte (C.)	R. E.	Iliff
Dunn	Q. B.	(C.) Andrews
Schneider	R. H.	Johnson
Haskins	R. B.	Mitchell
Linderholm	F. B.	McCauley

MINES 6, AGGIES 33—AT DENVER.

Being outweighed fifteen pounds to the man is enough to defeat any team. But the Mines went down to defeat before that great Aggie team fighting as it never fought before. In the second quarter they had little trouble in going through Aggies' line, and the score would have been different had they been able to hold out against their heavier opponents.

Early in the game it looked as though the Mines would be able to lower the Aggie scoring record of thirty-one points per game, which they maintained throughout the season. Upon two occasions the light Mines held the plunging Farmers on the fifteen-yard line for downs. Bresnahan ran back punts well, and on the third attempt for a touchdown the Mines finally weakened enough to give the Aggies a chance to put it across. In this quarter Aggies could only get within kicking distance, and Scott booted one over the field posts.

In the second quarter Mines took a brace and kept the ball in Aggies' territory all of the time. Mines received the ball on their twenty-yard line and began rushing it, but were forced to kick. A. Bunte made a splendid kick, placing Breshnahan down on his own ten-yard line. Ratekin kicked the ball to midfield and the Mines took possession of it and rushed it to Aggies' twenty-five-yard line before they lost it. Aggies punted and Dunn returned the ball ten yards. Mines opened up a brilliant offense and carried the ball to Aggies' ten-yard line by a series of rushes, aided by two forward passes, Schneider to Bunte, and Schneider to Dunn. Here they were again held for downs, but on receiving the punt Dunn ran the ball back twenty-five yards. A series of line plunges and a fifteen-yard penalty brought the ball to Aggies' ten-yard line. Here a "million-dollar play" by Schneider netted eight yards, and in a short time Schneider took the ball across. Gibbons failed to kick goal. Score, Aggies 10, Mines 6. The half ended with Aggies holding the ball.

Several substitutes were sent in at the beginning of the second half. Bresnahan kicked over the goal line and the Mines took it on their twenty-yard line. They were held for downs, and Bunte kicked to the Aggies' forty-five-yard line. A series of plunges and fake kicks and plays by Bresnahan, followed by a ten-yard gain through the line brought the ball on the Mines five-yard line. Bresnahan skirted around end for a touch-down. Ratekin kicked goal. Score: Mines 6, Aggies 17.

Mines kicked to Bresnahan, who ran the ball back to the fifty-five-yard line before being downed. It was a specimen of good broken field running. Hartshorn then broke through tackle for a thirty-yard gain. Mines was ragged and tackled poorly. A forward pass brought the ball on Mines' five-yard line, but here Aggies were held for downs, and Bunte kicked to Bresnahan, who returned it to the fifteen-yard line. A series of plunges put the ball over for a touchdown; Ratekin kicked goal. Aggies 24, Mines 6.

After Mines had received the ball on their twenty-yard line they fumbled. A series of plunges and a penalty forced the Farmers to kick and Ratekin kicked a perfect goal. Score: Mines 6, Aggies 27.

A poor kick by Aggies gave Mines an advantage, but they were held for downs. The Farmers soon made their way for another touchdown, but Poulin intercepted a forward pass and gave Mines the ball, and after two downs they kicked it to the middle of the field. Schweizer raced fifty yards with it before he was down. This placed the ball on Mines one-yard line. The next play he went over for a touchdown, but they failed to kick goal. Score: Aggies 33, Mines 6.

Bunte returned the kickoff twenty yards and a long forward pass to Dunn netted thirty yards. Here Mines lost the ball on downs. By a series of line plunges Aggies took the ball to the ten-yard line, when the whistle blew.

Bresnahan was easily the best man of the day. He ran back punts and caught forward passes in a brilliant manner. He was responsible for the Aggies' large score.

Dunn for the Mines showed up well in running back punts. He helped wonderfully to gain our touchdown. Schneider, Haskin and Linderholm made many a long gain and played steady football throughout the game.

The line-up:

AGGIES		MINES
Wood	L. C.	A. Bunte
Dotson	L. T.	Houssel
Scheeley	L. G.	Clough
Lieby	Center	Hyland
Ratekin	R. G.	Benbow
Hoerner	R. T.	Gibbons
Bresnahan	R. C.	E. Bunte
Mathieson	Q. B.	Dunn
Nye	L. H.	Schneider
Hartshorn	R. H.	Haskin
Scott	F. B.	Linderholm

Referee—Clem Crowley, D. U.; Umpire—Lee Koonsman, D. U.; Head Linesman—Curtis, Michigan.

MINES 0, U. OF C. 33.

The University of Colorado defeated the Colorado School of Mines by a very decisive score of 33 to 0 at Denver. Whatever the score may show the game was hard played, but we played in ragged fashion.

The field was in comparatively good condition, there being only a few small spots that were muddy. Most of these were covered with straw, so that there was little advantage or disadvantage in this respect to a light or heavy team. Both teams had a good chance to try their forward passes.

Boulder made frequent gains by this method of attack, but Mines could not do much with them. Inaccuracy in passing was our chief trouble. The passes nearly always went wild. Boulder couldn't do a thing with the center of Mines line. "Fat" Hyland seemed to be immovable, but their end runs were very successful, especially the wide sweeping variety. Much ground was gained by the Boulder backs, because of their splendid broken field running.

Colorado kicked off to Mines on the five-yard line, who returned ten yards. Two plays through tackle netted eight yards, when a penalty gave Mines first down. Another six yards was gained in two rushes, but lost on an end run. Mines punted to Schrepferman, who returned twenty-four yards. Four rushes barely gave U. of C. their first down, and then Costello went around end for twenty yards; Abbott tore off ten more, placing the ball on Mines' four-yard line. Starks, in two rushes, put it over, and Boulder failed to kick goal.

Mines again received the kick-off on the ten-yard line, and returned thirteen yards. Here Mines began to get into action and soon placed the ball on Boulder's forty-seven-yard line. Haskin, Schneider, Linderholm were chiefly responsible for the work. Here the quarter ended. At the beginning of the second period Mines was forced to kick. It was Boulder's ball on the twenty-yard line. Boulder failed to gain and Mines received an on-side kick. Mines fumbled Boulder's recovery. Colorado made twenty yards around, but lost fifteen yards for holding. Here they tried a thirty-three-yard pass which put the ball on Mines' six-yard line. Costello carried the ball over and Schrepferman kicked goal. Boulder 13, Mines 0.

Boulder kicked to Schneider, who returned twenty-two yards. On the next play Boulder was off side, and then Mines fumbled, Boulder recovering.

Schneider intercepted a forward pass, but the play was brought back, and the ball given to Colorado. In three rushes the ball was placed on Mines nine-yard line, and the ball was put over in the next few downs. Boulder kicked goal, making the score 20 to 0.

Colorado kicked over the goal line. Mines took the ball on their twenty-yard line. They failed to gain and an exchange of punts followed, which resulted in Mines recovering one of the onside kicks. A desperate effort was made to put the ball across, but the one-yard line was as far as they could go. It was Boulder's ball, and they gradually raced it over for another touchdown. Score, 26 to 0. The half ended soon after the next kick off.

Both teams began to lag during the next period, not more than one-third of the plays being made that occurred in the previous periods. Mines received the kick-off, but a penalty against Boulder for holding placed the ball on the forty-yard line. Boulder held, but on an onside kick Mines recovered on Colorado's twenty-six-yard line. After Mines gained eight yards, Boulder was again penalized. This placed the ball on Boulder's one-yard line. With four downs to make it in, it looked as though nothing could stop them from a touchdown. Through line smashes netted a loss of two yards, and on a forward pass Schrepferman knocked the ball to the ground. In the remainder of the period Boulder gained a little ground on exchange of punts.

In the fourth period Colorado started another march toward the goal line, and after a few end runs and forward passes the ball was pushed across for their last touchdown; the score, 33 to 0.

The remainder of the contest was merely up to Boulder, and they kept the ball out of danger and so considerable punting was resorted to. The Mines were trying hard to get away with end runs or forward passes, but lacked strength to do much against the heavier opponents. Some good gains were made, but not consistent nor reliable.

Schrepferman and Costello played the best game for Boulder. Their best work was executed in broken field running. It seemed impossible to down these men. Several times they broke through the line, but the deadly tackle of Dunn always stopped them from scoring.

Dunn, Benbow and Hyland did excellent work for the Mines. Boulder found it hard to get through either Hyland or Benbow. Robertson did some good work at end and was always fighting. He stopped many a man that would have probably gotten away for long gains. The substitutes gave a good account of themselves, especially Hamilton and F. Robertson.

So badly were the Mines in need of back field men that Glaze had to use A. Bunte, who usually plays at end or at tackle or at full. He did well at that position.

The line-up:

COLORADO		MINES
Noggle	L. E.	A. Bunte
W. Adams	L. T.	Gibbons
V. Adams	L. G.	Clough
Franklin	Center	Hyland
Hogan	R. G.	Benbow
Muth	R. T.	Morton
Brown	R. E.	E. Bunte
Schrepferman	Q. B.	Dunn
Costello	L. H.	Schneider
Abbott	R. H.	Haskin
Starks	F. B.	Linderholm

Mines Subs—Gallucci, Hamilton, Robertson.

Score by periods:
First period—Colorado 6, Mines 0.
Second period—Colorado 26, Mines 0.
Third period—Colorado 26, Mines 0.
Fourth period—Colorado 33, Mines 0.

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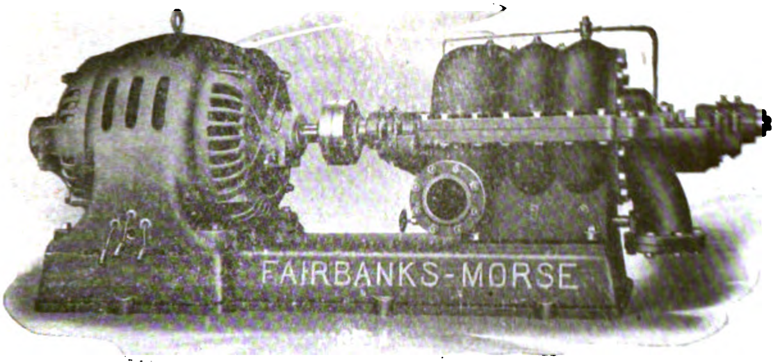

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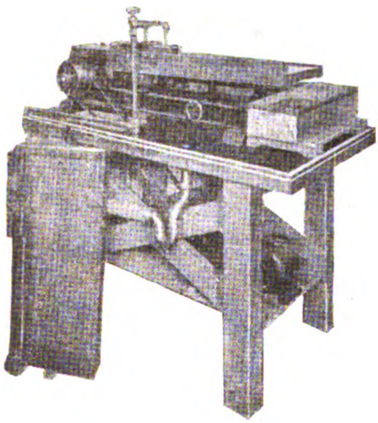

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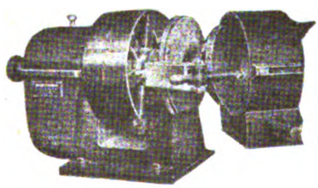

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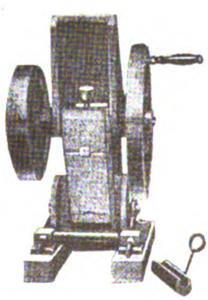

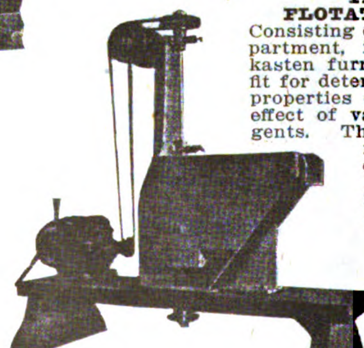

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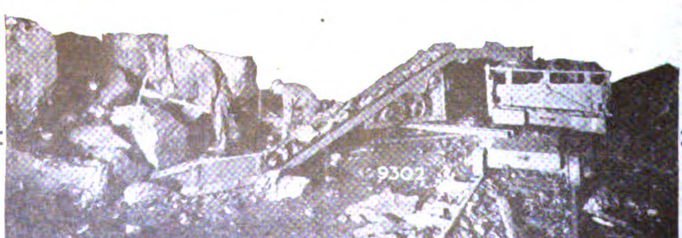

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